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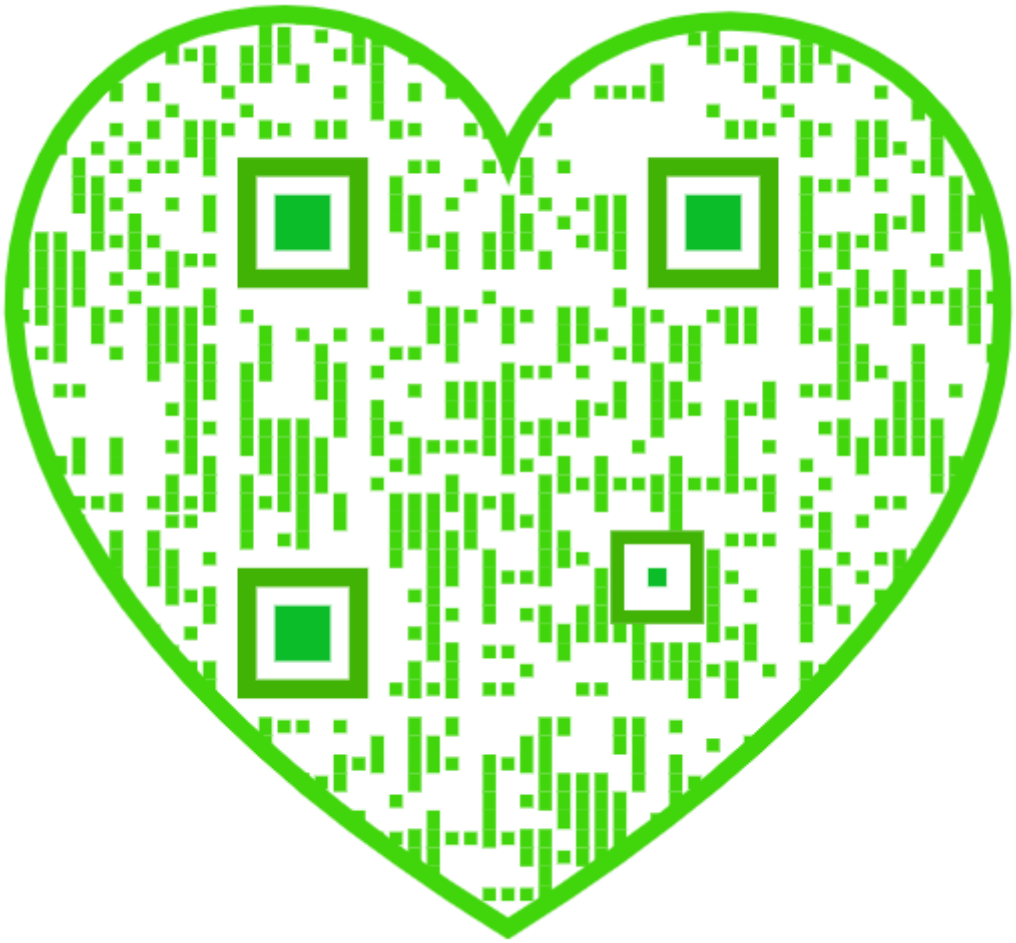

PRACTICAL TANNING

SETTING OUT CHROME-TANNED LEATHER.

Frontispiece

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PRACTICAL TANNING:

A HANDBOOK

OF

MODERN PROCESSES, RECEIPTS, AND SUGGESTIONS

FOR THE

TREATMENT OF HIDES, SKINS AND PELTS OF EVERY DESCRIPTION,

INCLUDING

VARIOUS PATENTS RELATING TO TANNING, WITH SPECIFICATIONS.

BY

LOUIS A. FLEMMING,

AMERICAN TANNER.

THIRD EDITION, IN GREAT PART REWRITTEN AND THOROUGHLY REVISED.

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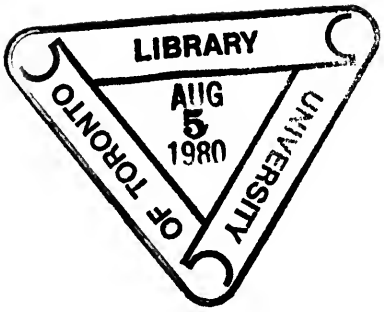

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PREFACE TO THE THIRD EDITION.

The second edition of "Practical Tanning" having been exhausted in a comparatively short time, and there being a continued demand for the book, the publishers have deemed it advisable to issue a third edition. Acting upon their suggestion, the author has carefully revised and in great part rewritten the volume, incorporating into it much new and valuable information, that should prove of service to anyone that is desirous of acquiring a knowledge of modern methods of the leather-dresser's art.

Like the first, and second, editions, this volume presents the results of the author's studies and researches, as well as of his own experience and that of other practical men with whom he has come into association and consultation. Nothing has been incorporated that has previously appeared in any other American of English work on the subject. The author has, however, consulted and made free use of the trade papers, and particularly acknowledges his indebtedness to THE SHOE AND LEATHER REPORTER, Boston, Mass., for material taken from its columns, and also to THE CASSELLA COLOR CO., of New York, for information relative to the most approved methods of dyeing leather and furs.

This volume is, as the title indicates, essentially a practical, and not a theoretical or technical, treatise, and it has been aimed to give the details of tannery processes with such clearness and precision that nothing further in the way of explanation is required. The receipts, formulas, and instructions that are given have been used in actual practice, or been tested experimentally, and their value has thus been demonstrated. Carried out with intelligence and care, they will produce satisfactory results.

In the Appendix a number of patented processes are described. No doubt the intelligent tanner and student will find much of interest and suggestion in this portion of the book.

The full table of contents and exhaustive index with which the volume is supplied render reference to any subject or detail in it, prompt, easy, and satisfactory.

The author presents this new edition of "Practical Tanning" with confidence in its superiority over its predecessors, and he believes it will be appreciated for its practical usefulness. He would like to receive from those who use his book, expressions of their opinion of the same, also any suggestions, receipts, formulas, and descriptions of processes that may be of assistance and interest to others. He may be addressed in the care of the Publishers.

LOUIS A. FLEMMING.

CHICAGO, ILL., *October, 1916.*

CONTENTS.

SECTION ONE.

The Manufacture of Sheepskin Leathers.

PAGE

Soaking green-salted sheepskins; Soaking dry sheepskins 1
Removing the wool; Formulas for depilatories 2
Applying the depilatory paint; Liming after removal of the wool . . 3
Methods of deliming (drenching) with bran; Formulas for bran drenches . 4
Lactic acid and butyric acid as deliming materials for sheepskins. . . 5
Deliming glove leather and glazed leather; Pickling with acid and salt . 6
Pressing the grease from pickled sheepskins; Two-bath chrome tanning . 7
Method of chrome tanning in which bichromate of potash or bichromate of soda is used 8
One-bath process 9
Method of tanning pickled sheepskins into plump, well-tanned leather. . 10
A process for glove leather 11
Neutralizing and washing chrome sheepskins; Dyeing chrome sheepskins black; Blacking with hematite and direct chrome black 12
Blacking with logwood and titanium-potassium oxalate 13
Redyeing colored skins black; Fat-liquors for chrome-tanned sheepskins; Modes of fat-liquoring 14
Receipts for fat-liquors. 15
Methods of coloring chrome-tannned sheepskins; General use of artificial dyes for this purpose; Preparation of the skins for dyeing. . . . 17
Coloring with acid dyestuffs 18
Coloring with basic dyestuffs. 19
Gambier mordant; Fustic mordant 20
Sumac and titanium-potassium oxalate: Combined dyeing process; Method of obtaining colors of superior fastness 21
Dyeing light shades with acid dyestuffs. 22
Value of diamine colors; Acid colors and bisulphate of soda . . . 23
Coloring with phosphine dyestuff; Fustic and logwood mordant; Sumac and acid color mordant; Practical formulas for popular shades . . . 24
Coloring after fat-liquoring 26
Flesh-finished chrome sheepskins. 27
Coloring chrome-tanned sheepskins after fat-liquoring and drying out . . 28
Dyeing and fat-liquoring chrome sheepskins after drying out from the chrome tannage, by the process invented by Robert W. Griffin 29
White chrome tanned sheepskins 30

PAGE
The finishing of chrome-tanned sheepskins; Black glazed finish . . . 31
Formulas for seasonings 32
Seasoning for dull finish 33
Degreasing sheepskins 34
Degreasing leather according to The Leather Trades Review; Method of degreasing followed out in Buenos Ayres 35
Alum tannages for pickled sheepskins 36
Depickling alum-tanned sheepskins; Coloring alum-tanned leather . . 40
Coloring with natural dyestuffs, and receipts for that purpose; Camel brown; Chestnut brown. 41
Coffee brown; Flesh color; Green; Lilac; Olive green; Rose color; Violet; Dark yellow; Azure blue 42
Blue dye; Brown; Tanning with formaldehyde; Eitner's process . . 43
Other processes of formaldehyde tannage 44
Nappa leather for gloves and mittens; Tawing and retanning the skins . 45
The two-bath method of tanning the skins 46
Coloring the leather 47
Vegetable-tanned sheepskins; Quebracho tannage 48
Hemlock tannage. 49
Combination tannage 50
Sumac tannage; Tanning with alum, sumac and oak bark 52
Tanning with chestnut extract; Tanning with sumac, alum and salt; Methods of dyeing vegetable-tanned skins; Blacking vegetable-tanned skins. 53
Dyeing with acid and basic dyestuffs 54
Clearing bath; Coloring with aniline dyestuffs; Preparation of the skins for dyeing 55
Oxblood shade 57
Brown shades 58
Fat-liquoring; Dyeing with fancy effects; Marbled effects 59
Production of antique effects. 60
Bronze dyeing (dyeings with metallic luster) 61
Dyeing by the staining process; Seasonings for colored skins . . . 63
Finish for embossed sheepskins; Finish for black embossed sheepskins. . 64
The coloring and finishing of India-tanned skins 65
Washing the skins 66
Retanning with sumac; Coloring the skins 67
Dyeing the skins black. 69
Notes on coloring India-tanned sheepskins and goatskins 70
Clearing pickled sheepskins tanned in sumac; Selection of dyes for ooze leather; Dyeing leather that has a very defective grain 71
Finishing the leather; Black glazed finish; Smooth dull finish; Finish for colored skins 72
Retanning with chrome liquor; Morocco finish 73
Mode of obtaining crushed levant grain; Ooze or Suede leather . . . 74
Methods used in finishing India-tanned ooze leather 75
Flat finishing of skivers 76

PAGE
Sheepskin fleshers, and modes of tanning them 78
Process for sheepskin splits that produces stock that closely resembles castor or mocha leather 79
Chamois leather; Preparations of the skins; Beating and oiling the skins . 80
Coloring chamois leather 81
Bleaching chamois leather 83
Roller leather; Skins used for this purpose; Tanning the skins . . . 85
Finishing the leather; The tanning of woolskins; Soaking, washing and scouring 86
Liming the skins 87
Tanning the skins; Various processes for this purpose 88
Bleaching the skins; Degreasing the skins 89
Tanning with formaldehyde 90
Tanning with gambier; Tanning with alum, salt and hemlock extract . . 91
Coloring woolskins and shearlings. 92
Method of getting a slight gloss on the wool; Dyeing woolskins black . . 94
Semi-chrome leather; Skins particularly suitable for this process . . . 95
Splitting and shaving the goods; Stripping the tannage 96
Chrome retanning; Neutralization; Dyeing the leather 97
Fat-liquoring 98

SECTION TWO.

The Manufacture of Calfskin Leathers.

Soaking green-salted skins; Soaking dry skins 99
Liming and unhairing, and various processes for these processes . . . 100
Method of liming with lime and sulphide of sodium 103
Bating and various methods for this purpose. 104
Use of ammonium butyrate for deliming and bating 106
Butyric acid for pickling calfskins for chrome or vegetable tanning; Test for deliming; Pickling with formic acid and salt 107
Processes of chrome tanning; Two-bath process 108
One-bath process; One-bath process with sulphate of alumina . . . 109
Neutralizing the leather 110
Dyeing chrome-tanned calfskins black; Dyeing with logwood and direct leather black; Dyeing with logwood, leather black and titanium salt; Dyeing with acid blacks 111
Fat-liquoring 112
Formulas for fat liquors that can be used on black or colored leather . . 113
Oiling the leather. Dampening and staking 115
Glazed finish; Seasoning for glazed finish 116
Smooth dull finish and seasoning for same; Gun-metal finish . . . 117
Bright finish, smooth or boarded; The coloring of chrome-tanned calfskins. 118
Coloring with acid dyestuffs. 119
Coloring with basic dyestuffs; Gambier and fustic mordant 120
Sumac mordant; Fustic mordant. 121
Clearing the grain and setting the color with tartar emetic; Manner of dyeing light shades of color 122

PAGE
Popular shades of color and formulas for same 123
Dark oxblood shade 125
Chrome-tanned wax calf leather; Skins that may be used for this purpose . 126
Process of retanning; Fat-liquoring 127
Formulas for black and for paste 128
Formulas for finish; Calfskin glove and mitten leathers; Process of tanning. 129
Method of securing a light yellow color without the use of artificial dyestuffs. 130
Manner of producing various shades of color. 131
Tanning with sulphate of alumina; Preparation of the tanning liquor; Fat-liquoring 132
Finishing; Formaldehyde tannage 133
Chrome-tanned ooze calfskins; Skins suitable for this purpose; Liming, bating and pickling the skins 134
Tanning and finishing the skins 135
Another way to produce ooze leather; Fat-liquor for light skins . . . 136
Finishing velvet or suede leather from chrome calfskins 137
The manufacture of vegetable-tanned calfskin leather; Quebracho tannage. 138
Gambier tannage 139
Dongola tannage 141
Fat-liquoring vegetable-tanned calfskins; Formulas for fat liquors . . 143
Notes on fat-liquoring 145
Dyeing vegetable-tanned calfskin black; Logwood liquor; Blacking with logwood and the salt of titanium 146
Dyeing with direct leather blacks, and formulas for this purpose . . . 147
Formulas for a purplish-blue and for a blue flesh, and for yellow back . . 148
Acid and basic blacks 149
Strikers for use after logwood; The coloring of vegetable-tanned calfskins; Dyestuffs used 150
Titanium mordant of colors 151
Velvet and suede leathers; Skins for this purpose and modes of preparing them. 152
Coloring and finishing the leather. 153
Coloring quebracho-tanned skins 155
Notes on ooze calf and Russia chrome leather; Method of making fancy ooze colors. 157
Mode of applying basic dyes. 158

SECTION THREE.

The Tanning and Dyeing of Furs and Hair Skins.

Soaking the skins 160
Tanning the skins; Method described by M. C. Lamb; Other processes . 161
Treatment of the tanned skins 162
Washing greasy skins; Oil process of tanning furs described by M. C. Lamb. 163
Oiling alum-tanned skins; A method of degreasing skins 164
Deodorizing furs and rugs; How to clean furs; Liming skins before tanning. 165

PAGE
Chrome-tanned furs and woolskins 166
Formula for the chrome liquor 167
To clean white fur rugs. 168
To clean skins with the hair on; To dye China goat skins 169
Dyeing furs with acid colors. 170
The chlorinating of the furs; Dyeing the furs with acid colors . . . 171
Formulas for various colors; Dyeing with chromate colors 172
Dyeing furs black with furrol dyes; Preparation of the skins; Drum killing and soda solution; Drum killing with milk of lime 173
Drum killing with caustic soda lye; Brush killing with caustic soda lye; Mordanting the furs; Solutions used as mordants 174
Dyeing black; Racoon (imitation skunk); Dyeing lambskin and red-haired fox 175
Dyeing red-haired fox black; Dyeing black seal rabbit; The tanning of hides for robes, coats, etc. 176
Alum and salt process 177

SECTION FOUR.

The Manufacture of Goatskin Leather.

Soaking dried skins 180
Softening dry-salted skins; Softening with bisulphite of soda; Painting the skins with lime and red arsenic. 181
Liming, and processes for that purpose. 182
Bating; Bating or puering with hen and pigeon droppings and dog dung . 183
Bating for goatskins for chrome tanning 184
Deliming and bating with ammonium butyrate; Pickling with sulphuric acid and salt; Pickling with formic acid and salt 185
Pickling with sulphate of alumina and salt; Two-bath processes of chrome tanning; Constitution of the baths 186
Various processes of tanning. 187
Tanning in a paddle vat 188
Tanning with sulphate of alumina, sal soda and chrome liquor . . . 189
Process of alum and chrome tanning 190
A new two-bath process of chrome tanning; Preparation of S. K. solution . 192
Neutralizing and washing the tanned leather; Neutralizing with borax . 193
Notes and suggestions 194
The difference between one-bath and two-bath chrome-tanned leathers . . 196
The process of fat-liquoring; How the fat liquor should be constituted. . 197
Receipts for fat liquors. 198
Use of sulphonated oil in fat liquors; Fat liquor for heavy skins, black or colored 199
Fat liquor for chrome-tanned goatskins 200
Notes on fat liquors; Fat liquor for colored goatskins; The dyeing of chrome-tanned goatskins; Dyeing with acid colors 201
Practical method of coloring chrome goatskins with acid dyes; Dyeing with basic colors 203

PAGE
Sumac mordant for basic and acid dyes; Gambier mordant for tan shades; Process for tan and brown shades 204
Clearing the grain of grease; Mode of obtaining light shades . . . 205
The use of tartar emetic; Notes and suggestions on the use of dyes . . 206
Process of fat-liquoring and drying the leather, and then wetting back and coloring it with acid dyestuffs; Advantage of giving the skins a light retannage before or during the coloring process. 207
Points to be taken into consideration in the treatment and selection of skins for colored leather; Storage of dyestuffs 208
Mode of dissolving dyestuffs; Coloring with natural dyestuffs . . . 209
Light and dark tan shades; Ox-blood shade; Chocolate shade . . . 210
Dyeing chrome-tanned goatskins black; Dyeing with hematin crystals or logwood and direct leather black; Dyeing with logwood, leather black and titanium-potassium oxalate; Dyeing with chrome leather black. . . 211
Blacking with logwood and iron liquor; Dyeing with chrome leather black and logwood 212
Dyeing with logwood, permanganate of potash and iron liquor; The finishing of chrome goat leather; Oiling, dyeing and staking 213
To clear the grain of grease 214
Blacking defective spots; Black glazed finish, and formulas for same . . 215
Seasoning for colored leather; Dull finish 216
Alum and vegetable tannages; Alum tannage 217
Kid glove leather. 218
Vegetable-tanned goatskins 219

SECTION FIVE.

Some Practical Methods of Bleaching Leather.

Bleaching chrome leather; Bleaching with borax, sumac and sulphuric acid. 221
Bleaching with sugar of lead and acid 222
Bleaching with hyraldite; Bleaching with hydrosulphites 223
Bleaching with bisulphite of soda; Bleaching with sodium peroxide; Bleaching with permanganate of potash 224
Bleaching with borax and lactic acid; Bleaching with oxalic acid . . 225
Bleaching bag, strap and collar leather. 226
Bleaching with gold-dust washing powder and acid 228
Bleaching with tanning material alkali and acid. 229
Bleaching and finishing russet leather 232
Bleaching mill-stuffed harness leather 233
Bleaching, stuffing and finishing russet skirting leather. 234
Bleaching sole leather 235

SECTION SIX.

The Manufacture of Kangaroo Leather.

Characteristics of kangaroo skins; Soaking and softening the skins; Liming. 238
Bating and drenching 239
Pickling; Two-bath chrome process 241

PAGE
One-bath process 243
Neutralization and washing; Dyeing chrome kangaroo black, and formulas for the purpose 244
Fat-liquoring and formulas for same 245
Applying the fat-liquor; Oiling and drying 246
Finishing; Vegetable-tanned kangaroo leather; Quebracho extract tannage. 247
Gambier and sumac tannage. 248
Other tannages 249
Dyeing black grain and blue or black flesh 250
Yellow flesh and black grain; A method of finishing kangaroo leather, patented by Christian E. and Henry A. Lappe 251

SECTION SEVEN.

The Manufacture of Leathers from Cowhides.

Soaking green-salted hides 252
Soaking dry hides 253
Liming hides for upper leather 254
Sodium sulphide process for dry hides. 257
Notes for beamhouse work 258
Liming for thin grain. 260
Methods of bating; Bating with a mild fermented bate 262
Another and a simpler method 263
Bating with a bacterial bate 264
Pickling, and acids used for the purpose 265
Methods of splitting; Splitting out of lime; Splitting out of sulphate of alumina and salt pickle. 266
Splitting out of acid pickle 267
Processes of chrome tanning for side leather; Process for acid-pickled grains. 268
One-bath chrome processes for acid-pickled stock. 269
Process for alumina-pickled grains 270
Process for unsplit stock; Neutralizing and washing. 271
Chrome tanning with glucose. glycerine, steam and saccharine substances; Object of this process 272
Various processes 273
Practical methods of dyeing chrome leather; Dissolving the dyestuffs . . 275
Tannin mordant for basic dyestuffs 276
Mordanting with sumac and acid dye; Mordanting for dark tan; Oxblood shade 277
Chocolate brown shade; Red brown shade; Alizarine brown . . . 278
Dyeing chrome side-leather black, and formulas for the purpose . . . 279
Fat-liquors for chrome side-leather, and formulas for same 280
Fat-liquor for heavy chrome upper leather, and for grained side leather . 281
Fat-liquor for dull-finished leather. and for heavy grain chrome leather . 282
Finishing chrome side leather 283
Dull finish; Glazed finish 284
Boarded finish; Gun-metal finish 285

PAGE
Finish for storm grain leather; Finish for colored leather; Heavy chrome grain leather 286
Black chrome oil grain leather 288
Chrome side glove and mitten leather; Yellow leather. 290
Fat-liquor receipt; Finishing 291
Chrome bag and belt leathers 292
Soaking the hides; Liming; Deliming. 293
Pickling the hides; Tanning process 294
A process for rendering chrome sole leather waterproof. 296
Chrome-tanned harness leather 297
Liming, bating, and pickling the sides 298
Tanning and retanning the hides 299
Blacking and stuffing 300
Finishing; Chrome-tanned belt and strap leathers 301
Treatment of the hides for belting leather 302
Strap leather; Chrome leather from India-tanned kips; Retanning and finishing this leather 303
Patent tipping from India-tanned kips 305
White side leather; Treatment of the leather with flour 306
Finishing; Tanning with sulphate of alumina; Fat-liquoring with acid fat-liquor 307
Finishing the leather; Chrome velvet leather 308
Chrome-tanned patent leather; Selection of hides; Pickling and tanning the hides. 309
Coloring and fat-liquoring; Staking and finishing 310
Vegetable tanning process for side leather; A common method of tanning . 311
Tanning with hemlock and quebracho extracts; Tanning with quebracho extract 312
Characteristics of quebracho extract 313
Important point to be observed in using quebracho extract 314
Tanning with chestnut extract 315
The function of chestnut extract 316
Various ways of using chestnut extract. 317
Value of chestnut extract as a tanning material 318
Tanning with gambier, sumac and oak extract 319
Combination tannage for tanning hides. 320
Tanning with gambier; Combination process 321
Pressing and splitting; Notes on the tanning of heavy leather . . . 322
The only way to make durable sole leather 323
The best practice when several tanning materials are being employed . . 324
Formula for producing plump leather; Soaking; Liming; Bating; Tanning. 325
Retanning with gambier and sumac; A good retanning liquor for harness and other kinds of leather. 326
Retanning grains with sumac 327
Coloring and finishing vegetable-tanned upper leather. 328
Formulas for black flesh grain 329
Blue flesh and black grain; Yellow flesh and black grain 330

PAGE
Fat-liquoring and finishing side leather; Mode of applying fat-liquor to various hides of leather 331
Fat-liquor formulas 333
A method of finishing vegetable-tanned grains into black leather; Finish for bright boarded-grain leather 335
Finishing kangaroo side leather 336
Coloring vegetable-tanned side leather; Various methods of coloring the grains. 337
Coloring quebracho-tanned grains 338
Vegetable-tanned patent shoe tipping; Liming required for tipping . . 340
Tanning the hides; Retanning 341
The manufacture of Goodyear welting, and hides for the purpose. . . 342
Tannages suitable for welting; Fat-liquor for welting; Rough leather of soft tannage for welting. 343
Manufacture of bag and case leathers; Hides to be used for these leathers; Liming 344
Bating; Pickling 345
Tanning processes 346
Bleaching and coloring 347
Finishing rough leather 348
Finishing; Receipt for a good waterproof finish 349
Seasoning for a nice black luster; Finishing imperfect grains into patent tipping 350
Method of retanning; The manufacture of lace leather; Treatment of hides for this purpose; Chrome lace leather 351
Method of tanning; Fat-liquoring; Fat-liquors for chrome lace leather . 352
Alum-tanned lace leather; Preparation of the tanning liquor, and modes of tanning 354
Picker leather; Properties demanded of this kind of leather . . . 356
Tannages for picker leather. 357
The finishing of splits; Chrome-tanned splits and finishing them into gusset splits and glove and mitten leather; Coloring the splits 358
Vegetable-tanned splits 360
Method of tanning; Retanning rough splits. 361
Softening and stuffing heavy splits 362
Stuffing for wax splits. 363
Finishing for the black; Soap black 364
Flour paste; Finishing splits into Goodyears, chair splits, etc. . . . 365
White splits; Preparation of the tanning liquor 367
Finishing white splits; Formula for making grain leather from splits . . 368
A process of drum tanning for sole and belting leathers 369

SECTION EIGHT.

Processes, Receipts, Formulas and Notes.

NOTES AND SUGGESTIONS ON CHROME TANNING.

A practical one-bath chrome liquor; A chrome-alum tanning liquor . . 371
A method of neutralizing chrome leather 372

PAGE
A method of drying chrome leather before coloring and finishing it . . 373
To increase the suppleness of chrome leather 374
To dissolve chrome alum 375
A new process of chrome tanning; German patent taken out by M. F. Hirch. 376
The recovery of chrome residues. 377
Processes for the recovery of chrome 378
Depilatory compounds for woolskins and hairskins; Methods of mixing lime and the sulphides; Method recommended by the Light Leather Trades Federation of Great Britain; Preparation of a suitable depilatory paint for all kinds of skins 379
Method given by M. C. Lamb 380
The conservation of skin substance; The use of zinc chloride for this purpose. 381
Drying skins in process 382
A practical method of drying chrome leather before coloring . . . 383
Tanning with gambier, sumac and oak extract 384
How to make and use sulphonated oils 385
Manner of combining and sulphonating neatsfoot oil and cod oil . . . 386
How to use the sulphonated oils 388
Use of sulphonated oils in the drum tanning of sole leather 389
Notes on fat-liquoring; Fat-liquors with a soap base in the manufacture of upper leather 390
Qualities demanded of a good soap; Preparation of sulphonated castor oil . 392
Sulphonating the free fatty-acids contained in oils; Sulphonated soap . . 393
Tanning oils and their preparation; Castor oil and potash soap and fat-liquors; How to make castor-oil soap; How to make potash soap . . 394
Castor-oil fat-liquor; A process of fat-liquoring; New fat-liquors. . . 395
Oiling chrome leather. 397
Preservation of the finish and prevention of spewing 398
How to test neatsfoot oil; Cold test; The Maumené test 399
Leather staining; Best way for this purpose 400
Mode of obtaining the full depth of shade; Toning down of bright shades . 401
Dyeing bark-tanned leather; Improving the affinity of the dyestuffs for leather 402
Dyeing splits or leather with a severely damaged grain; Production of heavily-stuffed leathers in colors 403
Clearing and coloring skins and skivers; Preparation of the clearing bath; Treatment with sumac 404
Clearing India-tanned skins. 405
Light russet color on leather 406
Dark russet color on leather 407
Storing and dissolving dyestuffs; Correction of hard, calcareous water. . 408
Application of basic and acid colors 409
To soften hard water; How to color chrome leather after fat-liquoring and drying 410
To dye colored leather black 411
Coloring process for chrome leather; Titanium mordants for chrome and vegetable-tanned leathers. 412

PAGE
Some practical methods of dyeing with titanium on both chrome and vegetable-tanned leather 413
Black with logwood on chrome-tanned skins; Black on vegetable-tanned skins 414
Formic acid in leather dyeing; Lactic acid in coloring leather . . . 415
Acetic acid bath for use after dyeing; Dressings to prevent the fading of colored leather 416
Dressing for leather goods and furniture; How to remove spots and stains from leather 417
The use of acids in deliming and pickling; Lactic acid drench for sheepskins; Lactic acid drench for goat skins 419
Formic acid and lactic acid drench; Deliming and pickling skins with formic acid; M. C. Lamb's process. 420
Bating with sal-ammoniac and pickling with formic acid 421
Deliming with butyric acid; Drenching with boracic acid; Drenching and bating with ammonium butyrate 422
Methods of using ammonium butyrate. 423
Test to determine the extent of deliming; Deliming horsehides, coltskins, cowhides, etc.; Heavy upper leather and patent leather 424
Depleting bate in cases where an extra fine grain is desired; Neutralization and removal of the lime 425
Treatment of skins designed for soft leather. 426
The tanning of sealskins; Division of raw sealskins into two classes; Levant grain 427
Unhairing the skins 428
Tanning the skins 429
Blacking and its application; Walrus grain seal; Splitting heavy skins . 430
Bating, scudding and drenching the split skins; Tanning process. . . 431
Tanning the splits; Directions for finishing the skins 432
Treatment for split linings; Utilization of the goods for colors . . . 433
Finishing operations; Splits for white shoes and their treatment. . . 434
The manufacture of pigskin leather 435
Washing and degreasing pigskins; Unhairing; Liming 436
Bating; Tanning pigskins 437
Various methods of tanning pigskins 438
White pigskins 439
Tannage for white pigskins. 440
The tanning of buckskins; Methods of removing the hair; White buckskin. 441
Tannages for white buckskin 442
Chrome-tanned buckskin 443
Two-bath process; One-bath method; White chrome buckskin . . . 444
Colored chrome buckskins; How to tan snake skins; Tanning with alum and salt. 445
Tanning with bark or extract; Process of tanning with alum, salt and gambier; Notes and suggestions for finishing leather; Seasoning for glazed chrome upper leather 446
Bright blacking varnish for shoe leather 447

PAGE
Waterproof leather dressing; Harness blacking; Oil black; Blacking for vegetable-tanned leather 448
Sigs for greasy leather; Logwood liquor 449
Dyeing chrome leather black; Boiling logwood chips; Blue flesh with nigrosine; Strikers for table dyeing 450
Blacking for the edge of chrome-leather; Preparing blood for leather finishes 451
Final dressing for box calf; Ointment for chrome sores; Treatment for acid burns; How to remove stains from the hands 452
To keep patent leather soft and to restore its gloss; To remove grease spots from leather; Waterproof leather without oily surface 453
A process of waterproofing leather with rubber 454
Mixture suitable for the purpose 455
Treatment of the hides 456
Another process of waterproofing leather 457
Butyric acid in chrome tanning 458

SECTION NINE.

Receipts, Formulas and Processes.—Continued.

Notes on the manufacture and application of fat-liquors; Formulas for various fat-liquors the most carefully guarded secrets of a leather manufacturer; Definition of a fat-liquor and its purpose. 460
The real inventor of the emulsified fat-liquor; Consideration of the general constitution and preparation of fat-liquors; Use of soap as an emulsifying agent. 461
Sulphonated oils; Castor oil the only oil that can be sulphonated in the true sense. 462
Casein; Eggyolk 463
Potash soap 464
Fig soap; Objections to the use of rosin oil 465
Materials used in finishing leather; Blood; Defibrinated blood and prevention of its putrefaction 466
Blood albumen; Egg albumen; Gelatine and glue: Varieties of glue . . 467
Principal constituents of glue; Chondrin and glutin; Manufacture of glue . 468
Isinglass; Casein 469
Various methods of producing casein 470
Irish moss 471
Algin and the method of extracting it from seaweeds; Shellac . . . 472
Varieties of shellac; Botton lac; Pyroxylin. 473
Uses of cellulose solutions for patent-leather manufacture and in making a cement for joining the laps of chrome-tanned belt leather 474
The use of formaldehyde in the tannery; Preservation of skins; Process patented by Roberts of Buenos Aires; Skins not permanently sterilized by salting 475
Soaking and liming skins; Fixing the swelling in vegetable tanning . . 476
Effect of formaldehyde on skins; and Prof. Eitner's practical hints on this point 477

PAGE
Miller patent of tanning with formaldehyde; Payne and Pullman's patent for the production of leather by means of a mixture of formaldehyde and alkaline substances, and outline of the process 478
Combret's patent for formaldehyde tannage; Eitner's instructions for treating sheepskins. 479
Preparing the skins for formaldehyde tannage; Sheepskin tannage . . 489
Tannage for kips. 481
Another process of formaldehyde tanning; The soaking of sheepskins . . 482
Soaking agents that might be used; Strength of bisulphite solution for attaining the best results 484
The Indian method of tanning buckskins; Methods of preparing the skin; Tanning material used 485
Stretching, drying and smoking the skin 486
Notes on glove-leathers; Skins the glove-leather manufacturer has to deal with; Process of glove-leather dressing 487
Soaking and painting the skins; Mixture for painting. 488
Puering or bating the skins; Drenching the skins; Dressing (tawing) liquor. 489
Process of making good glove-leather for heavy gloves; Method of retanning alum leather 490
Preparation of the goods for the process of dyeing; Methods of washing back before dyeing 491
Dye baths and time required for dyeing 492
Manner of working the grey shades; Dyeing black shades on alum leather . 493
Notes on dyeing chamois leather. 494
Mordanting for glove-leather shades; A popular shade of brown . . . 495
Methods of using patented depilatories; Mode of dissolving the crystals, and strength of the solution 496
Treatment of salted and dried stock 497
Treatment of light hair skins; Use of the dipilatory upon hides intended for sole leather 498
Application of the depilatory; Methods of unhairing; Treatment for belting, harness and patent leather 499
Treatment of horse hides; The production of a good color on heavily stuffed leather; Most important point to watch with regard to the production of a good color 500
Importance of the nature of the greases used; Mineral greases; One feature of the superiority of modern currying 501
Methods for the drum stuffing of leather 502
Stuffing of belting leather 503
Methods of drying 504
Bleaching the leather and agents for that purpose. 505
One-bath chrome tannages 506
Consideration of the economic side; Examples of cost of tanning liquors . 507
Modification of the liquor that it will produce good leather 508
Explanation of some of the observations on the behavior of the tan liquor . 509
A process of manufacturing chrome calf leather; Skins most suitable for dull finished or glazed finished leather; Preliminary treatment of the skins . 511

PAGE
Tanning the skins; Treatment of the leather 512
Fancy leather calf skins; Liming the skins 513
Deliming the skins and scudding them. 514
Pickling for this class of leather; Fat-liquoring, and formulas for this purpose. 515
Coloring and finishing the skins; The deliming test; Means to determine the completion of the deliming process 516
The phenolphthalein test; Confusion which may arise from this test illustrated by a definite example 517

APPENDIX.

Various Patents Relating to Tanning, with Specifications.

Leather for furniture, upholstery, carriages and automobiles, patented by Leon Feval 519
Way of carrying out the process 520
Application of the coatings 521
Pyroxylin in finishing varnish for patent leather, patented by Byron B. Goldsmith 523
Tanning and plumping leather with formaldehyde, patented by Dolley & Crank 525
A case illustrating the steps involved in the process 526
Special advantage claimed for this process; Leather for pneumatic tires and other special purposes 529
Another process for pneumatic tire leather 531
A process for finishing upper leather, patented by C. E. and H. A. Lapp . 532
A process for rendering leather waterproof, patented by Chas. Bohm . . 533
A process of tanning fish and other similar skins, patented in Europe . . 534
A process for producing marbled suede leather, patented by Carl Brandt . 535
A combined vegetable and mineral tannage, patented by Klipstein . . 536
Turkey-red oil (sulphonated oil) in tanning leather 537
Examples for using the sulphonates in tanning 538
Alum tawing with Turkey-red oil; Oil tanning or chamoising . . . 539
A process of alum tawing, patented by A. Warter and H. C. Koegel . . 540
A process of improving poor leather, patented in Germany 541
A novel method of tanning, patented by G. Durio, of Turin, Italy . . 542
A German process of tanning with formaldehyde 543
A method of degreasing skins, according to a French patent of M. J. Filhol. 545
The manufacture of intestinal leather, patented by Bruno Trenkmann, of Berlin, Germany 546
Manufacture of parchment-like skin, patented by Bruno Trenckmann, of Berlin, Germany 549
Leather for organ pipes 550
Tanning with alfalfa extract, patented by John H. McWhirter, Grand Valley, Oklahoma 551
Some patented processes of bating and deliming; Bating with sulphonated oil and sal ammoniac 552
Bating with bichromate of potash, patented by N. Wilson, Beckett, Mass. . 553

PAGE
Bating with glucose, sulphur and yeast, being Oaks patented process of bating 554
Bating with dog dung 555
Bating with molasses 556
Bating with dermiforma 557
Bating with bran; A quick waterproof tannage, patented by Joszyp Moszynski, Philadelphia, Pa. 559
A gambier and salt tannage, patented by Martin B. Lawson, Molson, Wash. 560
A process of salting hides to prevent salt stains and loss of weight, patented in Great Britain 561
Methods of coloring leather with permanganate of potash; Method patented by William M. Norris, Princeton, N. J. 564
Other methods of coloring with permanganate of potash 566
Tanning with lignite distillate in combination with tannic acid, patented by James C. Cleary, Chicago, Ill. 568
Another process of tanning with a lignite distillate 569
Waterproof filling for sole leather, patented by William R. Smith . . 571
A process of preparing a tanning agent from the waste products of wood-pulp manufacture, patented by Otto Grothe, Jersey City, N. J. . . 574
INDEX 577

PRACTICAL TANNING.

SECTION ONE.

The Manufacture of Sheepskin Leathers.

Soaking Green-salted Sheepskins.—The first process to which the tanner or the wool-puller subjects sheep pelts is soaking in water. The purpose of this process is to soften the skins and to dissolve the salt and remove the dirt and objectionable substances that adhere to them. Clean water should be used. In warm weather ten or twelve hours is generally sufficient time to accomplish the object of the process; in cold weather the skins can be soaked longer without injury. The softening and cleansing qualities of the water may be increased by the addition of borax, from one to two pounds for one hundred gallons of water. When the skins have become soft and clean they have been soaked enough; they should then be removed from the water and thrown over horses or otherwise allowed to drain for several hours, or they may be passed through an extractor and the surplus water removed from them. They should be clean and soft before any depilatory is applied to them.

Soaking Dry Sheepskins.—Sodium bisulphite is of much assistance in soaking dry sheepskins. It is inexpensive, only a small quantity is required; it does not swell the pelts and it has no injurious effect upon the wool. It also acts as an antiseptic and prevents the growth of micro-organisms which would produce decomposition and loss of skin substance. One pound of commercial sodium bisulphite is used for each hundred gallons of water in the soak vat. The dry pelts are placed in the prepared soak and allowed to remain therein until they are flexible and can be broken over the beam.

After they have been either broken over the beam or drummed for a short time, they are put into a fresh soak to complete the softening and they are then treated in the usual way. Very hard skins usually require a second soaking in the sodium bisulphite solution. Ordinary skins become sufficiently soft in twenty-four hours. It is always advisable to place the skins in fresh water a few hours after they have been softened to remove the sodium bisulphite from them as well as the last traces of salt and dirt. It is also good practice to use fresh solutions of the chemical for every two or three packs of skins. The next process is the removal of the wool.

Removing the Wool.—To accomplish the depilation of the pelts sulphide of sodium and lime are generally used in the form of a thick solution or paint, which is applied to the flesh side. Lime and arsenic are also used, especially upon skins that are to be subsequently tanned into glove leather. Several receipts for making the paint are here given.

1. Put 25 lbs. of lime into a tub and add just enough hot water to cover it. Stir the lime until it is entirely slaked and add more water as it is needed. In another tub or barrel dissolve 25 lbs. of sulphide of sodium in 10 gallons of hot water. Mix the lime and the solution of sulphide together and allow the mixture to become cold before applying it to the skins.

2. A suitable paint is prepared as follows: Use 60 lbs. of lime, 30 lbs. of sulphide of sodium and 20 gallons of water. Place a thin layer of the lime upon the bottom of a clean tub or vat; sprinkle on this a thin layer of the sulphide of sodium; and proceed to place the rest of the lime and sulphide in alternate layers. Ten or twelve gallons of hot water are next added, a little at a time, and the mixture is thoroughly slaked and then left over night. The rest of the water should next be added and then stirred up to a paint-like consistency. It is always advisable to pass a depilatory paint through a fine-mesh sieve in order to remove particles of unslaked lime, small stones, etc.

3. A good depilatory is made by dissolving sulphide of sodium in hot water until the solution stands at 18 or 20

degrees Baumé test, and then adding 18 gallons of slaked lime. Apply this mixture to the skins when it is cold.

4. A mixture of lime and red arsenic can be recommended for loosening the wool upon skins for glove or glazed leather since it makes fine, smooth grain. The proportions are 100 lbs. of lime and 25 lbs. of red arsenic, the two being thoroughly mixed together dry, and then slaked with 50 gallons of hot water.

Applying the Depilatory Paint.—Spread the skins, one at a time, upon a table and apply the prepared paint upon the flesh side; then fold the skin with the wool on the outside and place in piles until the next day, when the wool can be easily removed. Only enough of the mixture should be used to saturate the skin and cover it evenly and none should be allowed to run off into the wool. The workman should wear rubber gloves to protect his hands.

When the weather is cold six or seven skins may be placed in a pile, but during warm weather not more than three or four should be so placed, and if they are to be left for twenty-four hours or longer they should be singled out and each pelt lie by itself. The wool becomes loosened in a few hours, but it is best if it is not removed until the next day. Very young lambskins, however, should be "pulled" as soon as the wool is loosened and then be put into cold water to which some sulphide of sodium has been added; in this water they may be kept for some time without injury although it is advisable to pass them promptly into the lime.

After the wool has been removed from the skins dissolve 1 lb. of bicarbonate of soda in warm water for each dozen skins and wash them in a drum in this solution for one hour; next wash them in clear water for a few minutes and then put them into the lime liquor.

Liming after Removal of the Wool.—To start the liming of the skins slake 2 gallons of lime with 6 gallons of water for 100 average skins. Put the lime into water in a vat; put the skins in and leave them one day; then haul them out and add 1 gallon of lime slaked with 5 gallons of water and put

the skins in for another day; then haul them out and put in a little more lime and leave the skins in a day or two longer. The next process is deliming, commonly called drenching.

Methods of Deliming (Drenching) with Bran.—1. Take a half barrel of bran and add enough water to make it mushy; cover it up and let it stand in a warm place for 48 hours to sour. Into a vat large enough to process 400 skins run the requisite volume of water and empty into the same the sour bran. Add about 3 pints of sulphuric acid and 3 pecks of salt; mix thoroughly and heat to 90° F. Throw the pack of skins into the prepared drench and process them for three hours; heavy skins a little longer. The skins will be made soft and clean by this treatment and, if intended for black leather, will require no working on the beam, but if for colored leather it is advisable to work them out on the beam so that the grain will be clear and clean. Washing in warm water after drenching puts the skins into the best condition for pickling and tanning.

2. *Another formula for a bran drench* is as follows: Take 50 pounds of bran; add water to make a mush and let it stand until it is sour; then put the sour bran into a paddle together with 700 gallons of warm water. Add 10 pounds of sulphuric acid and process the skins until they are soft and clean. Rinse them in warm water; work them over the beam and then pickle them.

3. A process of drenching which the writer especially recommends involves the use of bran and lactic acid in the following manner: Run water into a paddle wheel and heat it to 120°. Put into the warm water two pailfuls of dry bran and let it stand over night. The next morning bring the temperature up to 95° F. Take one pint of lactic acid for each hundred pounds of skins and put about half of it into the bran liquor; throw the skins in and while the paddle is running add the rest of the acid. Run the paddle for from two to four hours according to the thickness of the skins and the amount of lime in them, then take the skins out and rinse them in warm water. This washing should not be

neglected, especially if the leather is to be colored. The skins, after they have been rinsed, are ready to be pickled. For the second pack of skins run the drench liquor down about twelve inches and run in an equal quantity of water. Heat the liquor to 95° F. Do not use any more bran but take a pint of lactic acid for every hundred pounds of skins to be treated and proceed exactly as described for the first lot. Continue in this way for six days; then run off the liquor and make up a fresh drench with water, bran and acid and proceed in the manner described. This method of drenching makes the skins soft and clean and in good condition for pickling and tanning, no matter what the tannage may be.

4. Lactic acid is an efficient deliming agent for limed sheepskins. For a pack of 800 to 1000 sheepskins 20 lbs. of the acid and 20 lbs. of salt are required. The water should be about 85° F.; if colder than this more salt is required to keep down the plumpness. Half of the acid and all of the salt are added to the water before the skins are put in; after the skins have been in the drench fifteen minutes the rest of the acid should be put in. The process requires usually about forty-five minutes. Several lots of skins may be put through the drench with a fresh addition of 15 lbs. of lactic acid for each lot, adding 5 lbs. at first and 10 pounds fifteen minutes later.

The skins can also be nicely drenched by using one pint of the acid for one hundred pounds of skins. And by careful and thorough washing before drenching the quantity of acid can be reduced one-third. Rinsing in warm water and pickling then follow in the usual order.

5. Butyric acid has been found to be an excellent deliming material for sheepskins. The quantity used for 100 lbs. of skins is 8 to 10 ozs. A few pounds of salt should be added to the acid solution. There is no loss of skin substance where this drench is used and the grain is made soft and clean.

6. A mixture of 4 parts formic acid and 1 part lactic acid is also very efficient for the purpose of deliming skins. It may be used after a bacterial bate, also to drench skins not other-

wise bated. The drench is prepared by adding a pint or more of the acid mixture to sufficient water to wash twelve dozen skins. In this bath the goods are drummed or paddled until their appearance indicates that they are delimed; after this they are rinsed and pickled.

Another efficient drench is prepared by using a half pint of the mixture of the acids and two pounds of calcium chloride for ten or twelve dozen skins.

7. For glove leather and for glazed leather the writer recommends the use of oropon, a commercial bacterial bate, for deliming the skins. From 6 to 8 ozs. of the material are dissolved and used for 100 lbs. of skins. The temperature of the water should be 100° F. at the start. Pour in the dissolved bate and then throw in the washed skins and run the paddle one hour. Allow the goods to remain in the liquor over night. The next morning stir them about for a few minutes and then take them out. It is of benefit to the skins to wash them in warm water to which some boric acid has been added. This removes the last traces of lime and makes the grain soft and silky. The process of drenching with oropon, washing in a boric acid drench and pickling with acid and salt insures fine grain, texture and color in the finished leather.

Pickling with Acid and Salt.—This process cleanses, bleaches and preserves the skins. Reliable formulas for the process are:

1. Dissolve 40 lbs. of salt in 40 gallons of water and add 5 lbs. of sulphuric acid to the solution. Use 12 gallons of this liquor for 100 lbs. of skins. Drum the skins in it thirty minutes, then horse them up to drain.

2. For skins that are to be vegetable-tanned, and when it is desired that the leather possess a certain degree of firmness, the best results are obtained by using 2 lbs. of sulphuric acid, 20 lbs. of salt and 20 gallons of water for 100 lbs. of stock.

3. Formic acid can be recommended for use in pickling. Skins pickled with it tan rapidly and with a nice light color, and less tanning material is required than when they are tanned without being pickled. When formic acid is used

there is no liability of lime blast causing trouble in coloring. Dissolve 25 lbs. of salt in 20 gallons of water; add to the solution 7 lbs. of formic acid. This quantity of liquor is for 100 lbs. of skins. Drum thirty minutes, horse up and drain.

4. Butyric acid is not only a perfect deliming agent for sheepskins, it is also of value in the process of pickling, especially for chrome tanning. Ten pounds of salt, 2 quarts of the acid and 15 gallons of water is the formula for 100 lbs. of skins. A soft grain and an agreeable feel result from the use of a butyric acid pickle.

Pickling removes whatever dirt and iron stains there may be on the skins, but it is a matter of importance that the salt that is used is clean and pure; otherwise it may cause stains that cannot be removed.

Pressing the Grease from Pickled Sheepskins.—The following method of removing grease from pickled sheepskins has been found satisfactory in every respect. Get a sufficient number of sheet-iron plates as large as the press (hydraulic) will take, about one-sixteenth of an inch thick. Place one dozen skins on each plate, spread out flat with the bellies and shanks folded in, so as to have each plate of skins about the same size. Place the butt of one skin as equally as possible over the other until the press is full. It will be seen that the pressure comes directly on the parts of the skins that need it most. After the pressure has been applied and the skins have been pressed throw them into a drum together with warm salt water and drum them until they have come apart and are well opened out. They are then in condition to be tanned.

It is advisable to place sawdust or bran between the layers of skins to keep them from slipping and to apply the pressure very slowly as the stock is easily damaged at this stage.

Two-Bath Chrome Tanning.—Good chrome leather can be made by using any one of the processes described below. The skins are tanned after they have been pickled and pressed.

1. Weigh the pack of skins to be tanned and for each hundred pounds of them use 6 lbs. of bichromate of soda, 4 lbs. of salt, 3 lbs. of muriatic acid and 15 gallons of water. This

is the first bath of the process. Throw the skins into the drum and set in motion. Pour the prepared solution into the drum through the hollow axle and let the drum rotate one hour and a half or until the liquor has struck through the thickest skins; then horse the skins up over night to allow for draining and for the chrome to become fixed in the fibers. The next morning prepare a 10 per cent. solution of bisulphite of soda and dip the skins one at a time into it, then throw them into the drum. The second bath is prepared by dissolving 12 lbs. of hyposulphite of soda and 3 lbs. of salt and adding the solution to 15 gallons of water, then adding to it 6 lbs. of muriatic acid. The skins are drummed in this liquor from one to two hours and are then again horsed up over night. The neutralizing and washing of the leather are then proceeded with and the skins are next shaved and fat-liquored.

2. In this process sulphuric acid is used in the first bath instead of muriatic acid and bisulphite of soda is employed in the second bath instead of hyposulphite of soda and acid.

For each 100 lbs. of pickled skins 6 lbs. of bichromate of soda, 2 lbs. of sulphuric acid and 4 lbs. of salt in solution with 15 gallons of water are used. The skins are drummed in the liquor from one hour to two hours and are then horsed up and allowed to drain until the next day. If the process is not completed the next day the skins should be covered up and kept from the light and not allowed to dry or harden. The second part of the process consists of a solution of 6 lbs. of bisulphite of soda in 15 gallons of water for 100 lbs. of stock. The drumming is continued for one hour or until the skins have assumed a light blue color throughout the thickest parts. This completes the tanning. After the leather has drained twenty-four hours it is washed and neutralized.

3. A method of chrome tanning in which bichromate of potash or bichromate of soda is used in the first liquor and hyposulphite of soda in the second bath produces leather well-tanned and of good texture. The skins may be tanned in the acid-pickled condition. It is also practicable to take them after the drenching and washing, and pickle them with 4 lbs.

of sulphate of alumina and 4 lbs. of salt per 100 lbs. of stock, using a drum for the process. Pickling with formic acid and salt is also recommended for this process of tanning, the pickle serving to some degree to fortify the fibers against the corrosive acids that are used in tanning.

The first or chrome bath consists of 6 per cent. of the weight of the pack of skins of bichromate of potash or of soda, 3 per cent. of muriatic acid and a few lbs. of salt, in 15 or 20 gallons of water if a drum is used, or in 60 gallons if a paddle is used. The stock is drummed in this liquor two hours or paddled in it several hours and allowed to remain at rest in it over night. The next morning the skins are struck out and dipped in a weak solution of hyposulphite of soda to which a little muriatic acid is added. After this has been done, the goods are allowed to drain a short time before they are placed in the second bath of the process. This bath consists of a solution of hyposulphite of soda, to which muriatic acid is added. The proportions are 18 lbs. of the soda and 5 lbs. of the acid for 100 lbs. of skins. The hypo is dissolved in boiling water and added to water in the paddle; the acid is then added and the previously chromed skins are thrown in and paddled several hours or until they are a light blue color throughout. The second bath can also be applied in a drum. The leather is allowed to drain 24 hours and is then neutralized.

One-bath Process.—1. The pickled stock is placed in a drum with 6 lbs. of salt and 8 gallons of water for 100 lbs. of stock and drummed fifteen minutes. Six pounds of tanolin dissolved in 2 gallons of boiling water is the tanning material that is used. The solution is divided into three portions. One portion is poured into the drum and the stock run for one-half hour; then another portion is poured in and the drumming continued another half hour; then the last portion is added to the skins and the drum run one hour. Eight ounces of bicarbonate of soda are dissolved in a little water and poured into the drum. One hour later 6 ozs. more of the soda are dissolved, the solution is poured into the drum and the skins are drummed another hour; they should then be

completely tanned. When removed from the drum they should be horsed up and allowed to drain 24 hours. They are then washed and neutralized.

2. A satisfactory method of tanning pickled sheepskins consists of first tanning them with sulphate of alumina and salt and then tanning with chrome liquor. When this process is used it is necessary to remove the acid from the skins. This is done by stirring them about for a few minutes in a warm drench of sour bran and salt. They are then in condition to receive the alumina and salt.

The usual formula for the preliminary tanning is: 3 lbs. of sulphate of alumina and 6 lbs. of salt for 100 lbs. of skins. These materials are dissolved in 6 gallons of warm water and the skins are drummed with it thirty minutes. The sulphate of alumina does not act as a tanning agent in this process as it is washed out before the leather is dried. It serves to plump the skins and to prevent contraction of the grain and fibers by the astringent chrome liquor. After the skins have been drummed with the sulphate of alumina and salt, 3 gallons of concentrated chrome liquor diluted with 3 gallons of warm water are poured into the drum in portions of 2 gallons at intervals of thirty minutes, and the drum is run for two or three hours or until the skins are tanned through. They should then be left in the liquor over night in order that the chrome salts may take full effect upon the fibers. The next day the tanned leather is washed and shaved in the usual manner.

3. Pickled sheepskins may be tanned into plump, well-tanned leather in the following manner: Dissolve 3 lbs. of sulphate of alumina and 3 lbs. of salt in a few gallons of boiling water; add enough cold water to make 10 gallons of solution. Add slowly to this 8 ozs. of bicarbonate of soda dissolved in a little hot water. Drum the skins with this liquor one hour; then hang them up to dry. When they are dry wet them back and tan them with one-bath chrome liquor in the usual manner. When a piece of chrome leather remains soft in boiling water the tannage is complete. Imperfectly tanned leather hardens and curls in boiling water.

A Process for Glove Leather.—The following method of handling pickled sheepskins for glove leather, although called a two-bath process, is really a three-bath process. The skins are not taken from the drum until they are fully tanned, and they then finish out into soft, durable leather.

The pickled skins are given a fairly strong repickle so that the grease will run good, and are pressed or wrung until as much of the natural grease as possible has been extracted. They should then be drummed in a salt solution until well broken up. Care should be taken after the skins have started in the press to keep the pressure steadily increasing. They are horsed up from the salt solution and allowed to drain before weighing. The skins are next weighed and thrown into a drum and 1 per cent. per one hundred pounds pickled weight, of salt is put on them, 3½ to 4 per cent. bichromate of soda is dissolved in 10 gallons of water for 100 lbs. pickled weight. This should be fed in two portions. The skins are drummed in this from two to three hours. This will be a short liquor but for the leather desired it works very well.

The next step is to put 3½ per cent. sulphuric acid in 10 gallons of water for each 100 lbs. of skins and 4 lbs. of salt for 2 lbs. of acid. This is fed through the gudgeon and the skins are drummed with the solution twenty minutes. Then 12 lbs. of hyposulphite of soda are dissolved in 12 gallons of water for 100 lbs. of stock and the solution is fed to the skins and drummed for two hours; this completes the tannage.

The leather, after it has been horsed up twelve hours, is washed and neutralized and then fat-liquored. If it is to be finished in the pearl or regular chrome color it should be given 2½ per cent. white chip soap boiled and made up to 10 gallons for 100 lbs. of leather and drummed twenty minutes, and then given 5 per cent. of eggyolks. Horse up and allow to drain twenty-four hours and then hang up to dry in a moderate heat; then drum the leather in warm water until it is thoroughly wet through, set it out and hang it up again. Finishing is done by staking on the machine, dry drumming with French chalk, and then staking again.

If it is desired to make colors, the fat-liquoring would necessarily have to be done without the soap and the skins would be colored with suitable dyestuff and handled in the finishing as regular chrome leather.

Neutralizing and Washing Chrome Sheepskins.—In every case of chrome tannage it is necessary to let the leather drain over horses or on smooth piles for from twelve to twenty-four hours before proceeding to wash and neutralize it. This is done to allow the chromium hydroxide to become dehydrated and fixed in the fibers.

The most efficient neutralizing substance for chrome leather is bicarbonate of soda. One pound is used for 100 lbs. of leather. It is dissolved in 10 gallons of warm water and the leather is washed in the solution thirty minutes. The plugs are next pulled out and the leather is washed another half hour with running water; it is then set out or pressed and shaved. Some tanners shave their leather before they neutralize it. Borax is also often used for neutralizing the skins. It is used in the same quantity and manner as bicarbonate of soda. After the skins have been neutralized and washed, they are struck out and shaved, then dyed black if black leather is wanted.

Blacking with Hematin and Direct Chrome Black.—A fine rich black is obtained on chrome sheepskins by carrying out the following instructions: Dissolve by boiling in 4 gallons of water 1 lb. of hematin crystals for 100 lbs. of leather; add to the solution 6 or 8 gallons of cold water, a small quantity of ammonia to make it slightly alkaline, and use it at a temperature of 125° F. After the leather has been run in this dye fifteen minutes, add to the liquor in the drum 1½ pounds of chrome leather black C (Cassella) dissolved in 5 gallons of boiling water and drum the leather fifteen minutes longer. Drain the liquor out of the drum and pour the fat-liquor in; then run the drum one-half hour; wash the skins in warm water, set them out, oil the grain lightly with neatsfoot or mineral seal oil, and hang up to dry.

Sheepskins that are designed to be given a glazed finish are

benefited by a light retannage with gambier before they are dyed. This assists in getting a fine color and finish and makes the leather less stretchy. The skins may be paddled or drummed in the gambier liquor.

Blacking with Logwood and Titanium Potassium Oxalate.—In this process of dyeing logwood extract or crystals, titanium salt and direct chrome black are used. The quantities of dyestuffs named are for 100 lbs. of shaved leather. Drum it in a solution of 3 ozs. of the chemical for ten minutes. Then pour into the drum a solution of 2 lbs. of logwood, ½ lb. of chrome leather black and 4 ozs. of sal soda in 12 gallons of water. Drum the skins in this liquor for twenty minutes; then pour in a solution of 3 ozs. of titanium potassium oxalate and let the drum run ten minutes longer. Then either drain the liquor out of the drum and run in the fat-liquor or wash the skins and then fat-liquor them.

Blacking with Direct Dyeing Chrome Black.—Put the leather, neutralized and shaved, into the drum together with 10 gallons of water at 125° F. for 100 lbs. of leather. Run for a few minutes. Then pour the solution of dyestuffs through the hollow axle of the drum. After about one-half hour drumming the dyeing will be completed. For blue-black with a blue flesh-side use from 1 to 1½ lbs. of chrome leather black C (Cassella) and 10 ozs. of chrome leather black 2061 J. It is advisable to add a small quantity of logwood liquor to the dyebath after a short drumming to fill the leather somewhat.

Fat-liquoring may be done either before, during, or after the dyeing. If the fat-liquor is added to the dyebath it is advisable to drum the leather in the dye liquor for fifteen minutes before adding the fat-liquor. Another method of blacking with direct chrome leather dyes is as follows: Use 4 or 5 ozs. of Nerazine G and 4 ozs. of chrome leather black C for 100 lbs. of leather. This produces a fine grain black and the blue-black flesh that is usually desired. Chrome leather black C used alone also produces blue-black flesh and black grain. The leather, thoroughly neutralized and fat-liquored with alkaline fat-liquor, is dyed for thirty minutes in

a drum with 2 lbs. of dye for 100 lbs. of leather, at a temperature of 120° to 140° F.

By dyeing first with 8 to 10 ozs. of chrome leather black C for twenty minutes, then adding to the liquor 1 oz. of acetic acid and ten minutes later a solution of 8 ozs. of leather black T B, drumming the leather ten minutes more, and then fat-liquoring it, a fine color is secured on both the flesh and the grain sides. A small quantity of logwood extract liquor added to the dye liquor is beneficial, increasing the fullness of the leather.

Redyeing Colored Skins Black.—Skins that have been colored and finished can be redyed black in the following manner: Drum them in hot water for a half-hour to remove the finish and to prepare them to receive the dye. Then for each dozen skins dissolve 6 ozs. of permanganate of potash in 6 gallons of warm water. Drum the skins in this solution fifteen minutes; then without stopping the drum pour into it 1 lb. of logwood crystals in solution with 10 gallons of hot water, and run the drum for one-half hour. When the half hour is up, pour into the drum a solution of 1 oz. of copperas and ½ oz. of bluestone and drum ten minutes longer. Then wash the leather in two changes of water, set it out, oil the grain and hang it up to dry.

Fat-liquors for Chrome-tanned Sheepskins.—After chrome-tanned sheepskins have been neutralized, washed and shaved they are either dyed and then fat-liquored or fat-liquored and dyed afterwards. Some tanners combine the two processes, first dyeing the leather in a drum and then running the spent dye liquor out and applying the fat-liquor; it is also practicable to add the fat-liquor to the dye liquor in the drum after the skins have assumed the desired color. The fat-liquor feeds and nourishes the leather. Sheepskins are naturally soft and do not require much fat-liquor; nevertheless, some grease and oil are required to impart to the leather the desired fullness and soft feel. When the fat-liquoring is a separate process a suitable drum is heated with live steam, the leather is thrown in and drummed ten minutes to warm it and make it more re-

ceptive to the fat-liquor. The fat-liquor is now poured into the drum through the funnel attached to the hollow axle and the leather is drummed with it for thirty minutes or longer or until it has absorbed the oil and grease and left the water behind. The temperature of the liquor may range from 120° to 150° F. After the process is completed the leather is taken out of the drum, and if it was not previously colored, it should be rinsed in hot water, drained and dyed; if it was colored before it was fat-liquored the custom is to strike it out, oil the grain, and hang it up to dry. Any one of the following receipts may be used with the assurance that the leather will be fat-liquored in a satisfactory manner.

1. For 100 lbs. of leather: One pound of Castile soap, 1 pint of neatsfoot oil, ½ lb. of eggyolk. Boil the soap in 2 gallons of hot water; add the oil and mix thoroughly. Then add cold water to make 12 gallons of liquor. When the temperature has been reduced to 80° F. by the cold water, add the eggyolk; mix thoroughly and heat to boiling point. Castor oil may be used in place of neatsfoot oil with equally good results.

2. For each dozen skins to be fat-liquored use 1 pint of eggyolk, ½ pint of olive oil, 4 ozs. of Castile soap, 6 gallons of of water. Chip the soap into the water and boil until it is dissolved; then stir in the oil. Boil the mixture of soap and oil; cool down to 100° F. and add the eggyolk. For glove leather make a paste of 1 pint of flour and cold water and stir it unto the soap, oil and egg solution. Mix thoroughly; run it into the drum at 110° F. and drum the skins with it thirty minutes.

3. Dissolve 8 ozs. of potash soap in a small quantity of hot water and stir the solution into 1⅓ lbs. of neatsfoot oil heated to 160° F. Mix thoroughly and allow the oil to cool slightly. Then add 1⅓ lbs. of sulphonated oil, thus making an emulsion readily soluble in hot water. Use 2 lbs. or more of this mixture for 100 lbs. of leather according to the degree of softness that is desired.

4. A fat-liquor considerably richer than the foregoing is

made of 2½ lbs. of neatsfoot oil, ½ oz. of carbonate of potash, ¾ lb. of potash soap and ¾ lb. of sulphonated oil. Mix and use the same as No. 3. This fat-liquor gives a well nourished, springy feel to the leather and there is no danger of spew.

5. Chrome-tanned skins can be nicely fat-liquored with egg-yolk and neatsfoot oil. Such a fat-liquor is especially suitable for colored leather. For each dozen skins use 1 pint of eggyolk and ½ pint of neatsfoot or olive oil. Beat the two thoroughly together and add warm water. Use at a temperature of 95° F. and drum the skins with it thirty minutes.

6. For chrome-tanned glove leather: One pound olive oil soap; 2 ozs. borax; ½ pound neatsfoot oil; 2 lbs. eggyolk for 100 lbs of leather. Apply before dyeing at a temperature of 125° F.

7. For 200 lbs. of skins, use soap, 8 ozs.; olive oil, 2 lbs.; treated cod oil, 2 lbs.; birch oil, 2 ozs.; salts of tartar, 3 ozs. Boil the soap, olive and cod oil in a few gallons of water, then add the birch oil. Stir the emulsion thoroughly, then add to it the salts of tartar dissolved in a little hot water. Add enough water to make 15 gallons of liquor and use at a temperature of 160° F.

8. A good fat-liquor for heavy dull-finished leather is made of soap, 1 lb.; neatsfoot oil, 3 lbs., moellon degras, 3 lbs., salts of tartar, 4 ozs. For 200 lbs. of leather. Boil the soap and oil in a few gallons of water, then put in the moellon degras and stir thoroughly. Dissolve the salts of tartar in a little water; add it to the mixture and stir again. Run in enough water to make 24 gallons of liquor and apply to the skins at 150° F.

9. The sulphonated oils that are now purchasable are of value in fat-liquoring. The oil is dissolved in hot water and the leather is drummed with the solution either before or after it has been colored. The oil can also be added to the dye liquor and applied to the leather in that form. It is generally best to pour it into the drum after the color has been taken up by the skins. When leather is fat-liquored with sulphonated oil before it is dyed it should be rinsed in hot

water afterwards and then given the sumac or gambier, and dyed the desired shade. A mixture of sulphonated oil and neatsfoot oil produces better results than the former used alone; a little ammonia should be added to the mixture.

In addition to the sulphonated oils there are several fat-liquors on the market that are blended and aged and used by many tanners in preference to liquors made in the tannery.

10. Castor oil soap and castor oil make excellent fat-liquor for colored chrome skins. One-half pound of the soap and ¾ lb. of the oil may be used in 12 gallons of water for 100 lbs. of leather. The fat-liquor is made by boiling the soap in a little water, then adding the oil and stirring and boiling the mixture; finally adding water to make 12 gallons.

Methods of Coloring Chrome-tanned Sheepskins.—The coloring of chrome-tanned sheepskins is accomplished in various ways. At the present time artificial dyes are in general use. Drum coloring is usually given the preference over paddle wheel, tray and brush coloring, since it accomplishes uniform dyeing of a large number of skins in a short time and with little labor. Skins that are to be colored should be prepared with particular care. Only sound skins are suited for the purpose and they should be well tanned, free from lime spots and discoloration, and the grain should be as free from natural grease as possible. It is also necessary that the process of tanning that is used should yield a leather that is soft and full after it has been dried and staked even though it is given very little fat-liquor or none at all. Complete neutralization of the acid in the skins is also of much importance. Even though acid dyes are applied it is always best to neutralize the leather before coloring it. Where there is acid in the leather the fat-liquor is imperfectly absorbed and the dyestuff is liable to be precipitated in the bath or taken up too superficially, and when it is finished the leather is liable to spew. If the skins are colored immediately after they have been neutralized and washed, the last washing should be in hot water, thus raising the temperature of the leather in anticipation of the dyeing process. The flesh side should be shaved smooth before the

skins are colored. Where fat-liquoring is done previous to dyeing it is essential that the liquor penetrates thoroughly into the leather and that it does not leave the grain greasy or sticky. Before it is colored the leather should be kept wet and protected as much as possible from light. Dyeing may be accomplished with acid dyestuffs direct without a mordant or with basic dyes after the skins have been mordanted with tannin.

Coloring with Acid Dyestuffs.—A practical method of coloring with direct acid dyes is carried out according to the following instructions: The skins, neutralized and shaved, are fat-liquored lightly and then rinsed in hot water. The skins and 12 gallons of water at 125° F., for each 100 lbs. of them, are put into the drum, which is then started. The dyestuff solution is then poured through the hollow axle into the rotary drum and the leather is drummed from fifteen to twenty-five minutes. Where good penetration is desired 1 or 2 ozs. of ammonia should be added to the liquor in the drum. At the end of the time stated the dye bath is acidified by the addition of sulphuric or formic acid. Enough acid should be used to neutralize the ammonia which may have been added and in addition to that quantity 2 parts by weight of formic acid or 1 part by weight of sulphuric acid for every 4 parts by weight of dyestuff should be used. The acid thus used fixes the color upon the leather in ten minutes further drumming.

To increase the fullness of the leather some sumac or gambier liquor should be added to the dyebath or run into the drum after the bath has been acidulated. This treatment is particularly advisable if the skins are to be glazed.

Any acid in the leather is removed by washing the skins in water to which 4 ozs. of acetate of soda crystals for 100 lbs. of leather have been added.

The sumac liquor referred to is a decoction of 6 to 8 lbs. of sumac leaves or sumac powder with 5 gallons of hot water. Two gallons of such liquor are used for 100 lbs. of leather. It may be added to the dye liquor at the beginning of the process; and after twenty minutes or so the solution of 3 to 4 ozs.

of sulphuric acid or three times as much bisulphate of soda in one gallon of water is added gradually while the drum is turning; the drumming is then continued ten or fifteen minutes. The colored leather is then rinsed and passed on for further treatment. The temperature of the dye bath should be from 120° to 140° F.; and it is good practice to pass the skins through water at 140° F. or to drum them with it before throwing them into the drum.

The richest and fullest coloring results when acid colors are topped with basic dyestuffs. This is done by adding a solution of 2 ozs. or more of some basic color to the dyebath as soon as all the acid color has been exhausted from the dyebath by the addition of sulphuric acid. If this cannot be effected completely, the basic color is applied by drumming the leather in a fresh bath, in which case no further rinsing is necessary.

Acid dyestuffs are dissolved by pouring boiling water over them and boiling up if necessary. The solution is then passed through a piece of cheesecloth or a fine sieve, and any particles remaining undissolved are brought to solution by pouring some more boiling water over them. Sulphuric acid, which is used in the dye baths to get the full shade, may to very great advantage be replaced by formic acid. Formic acid, after the process is completed, is entirely removed from the leather by evaporation and hence is harmless after it has served its purpose in the dyeing operation. No harm results to the leather when an excess of formic acid is used as it evaporates during the drying of the leather. It is necessary to use just twice as much formic acid as sulphuric acid but the advantage of doing so offsets the extra cost.

Coloring with Basic Dyestuffs.—Basic colors are applied to chrome-tanned sheepskins in the following manner: The neutralized and shaved leather is treated in a drum with a sumac, gambier or fustic liquor. After this has been done the dyeing is proceeded with, the process lasting twenty minutes or longer at a temperature of 125° F. It is always advisable to add the solution of dyestuff in several portions through the hollow axle while the drum is turning.

A decoction of 7 or 8 pounds of sumac leaves or sumac powder with 5 gallons of hot water is suitable for mordanting the leather. For very light shades 6 quarts of such liquor are sufficient for 100 lbs. of leather; for dark shades from 8 to 10 quarts. It should be strained before it is used. As the sumac bath by itself fastens the tannin to the skin in an uncombined state, a solution of tartar emetic is generally used to overcome the uncombined tannin and to fix the color upon the leather. After the skins have been treated with the sumac, the solution of tartar emetic is poured into the drum and the process is continued fifteen minutes. The leather is then rinsed in warm water, the spent liquor is run into the sewer, and the leather is dyed with the basic color. From 8 to 12 ozs. of tartar emetic are used for 100 lbs. of leather.

Basic dyestuffs are dissolved by stirring them into boiling water, to which some acetic acid has been added to overcome hardness. The solution should be strained before it is used. Dyestuffs that do not dissolve readily are mixed to a paste with acetic acid and boiling water is then poured over the paste. The solution is then strained through cheesecloth or a fine sieve, cooled down with cold water and applied to the leather at a temperature of 125° F. The skins should always be kept in motion while the dye is being poured into the drum and the drum should not be stopped until the leather has been drummed with dye at least ten minutes.

Gambier Mordant.—Two or three pounds of gambier for one hundred pounds of leather is another excellent mordant for basic dyes. Boil the gambier in four gallons of water; then add cold water to make twelve gallons of liquor. Use at 125 degrees F., and drum the leather with it thirty minutes. Then dissolve four ounces of titanium-potassium oxalate in hot water, pour the solution into the drum and run ten minutes longer. Drain the liquor out and proceed to color the leather with the basic dyestuff. Quermos extract may be used in place of gambier with equally good results.

Fustic Mordant.—Fustic extract is an excellent mordant for shades of tan and yellow. Use two to three pounds for one

hundred pounds of leather. Dissolve in boiling water; then increase to twelve gallons by the addition of cold water and use at a temperature of 125 degrees F. Drum the leather twenty minutes. Then dissolve and add four ounces of titanium salts and let the drum rotate fifteen minutes longer. Drain the liquor off and color the leather with aniline dyes.

Two pounds of gambier and one pound of extract of fustic is also an excellent mordant for basic or acid dyes. Use with titanium-potassium oxalate the same as gambier or fustic used alone.

Sumac and Titanium-Potassium Oxalate.—Four ounces of liquid extract of sumac may be used for each dozen small and medium-sized skins. The sumac is mixed with hot water and the skins are drummed with the liquor twenty minutes. Then pour into the drum the solution of titanium salts (one-half ounce to one ounce for one dozen skins) and run the drum ten minutes. Wash the skins and dye with basic colors or dye them with acid colors without first washing them. Dry powdered sumac may be used. The particles of sumac serve the useful purpose of taking up whatever grease there may be upon the grain as well as acting as a mordant by giving up tannic acid.

Combined Dyeing Process.—Bottoming with acid dyestuffs or with diamine and anthracene colors and then topping with basic dyes is a most excellent method of coloring chrome-tanned sheepskins, especially if they have damaged grain and it is desired to cover up such defects as much as possible. The coloring is usually done in two baths, *viz.* the bottoming and the topping bath.

The leather is first drummed with the requisite quantity of fustic extract. The solution of dyestuff is then poured into the drum and the drumming is continued another half-hour and complete absorption of the dyestuffs is then brought about, if necessary, by the addition of 2 to 3 ozs. of acetic acid per 100 lbs. of leather.

Colors of very superior fastness may be obtained by adding about 4 to 8 ozs. of bicarbonate of potash to the bath charged

with anthracene colors before the addition of acetic acid, and by working the goods at as high a temperature as possible, 150° to 160° F. The color solution is then drained out of the drum and the leather topped with basic colors in a fresh bath.

The skins are fat-liquored either before the dyeing or after the topping with basic colors. In the latter case they should be rinsed thoroughly before they are fat-liquored. Acid, diamine, anthracene and basic colors can be especially recommended for full, even and rich shades. The quantity of dyestuffs required to color a lot of leather depends, of course, upon the size and condition of the skins, and must be decided by the dyer. It is always wise to try a few experiments on a small scale before proceeding to carry on dyeing operations on a large scale.

Dyeing Light Shades with Acid Dyestuffs.—When light shades such as grey, drab, champagne, pea green, beige, etc., are wanted, the skins should be colored in the following manner: They are neutralized, shaved, weighed and then drummed with the solution of acid dye, according to the shade that is desired, for ten minutes. Then the fat-liquor is poured in and the leather is drummed twenty minutes. The procedure can also be reversed by first fat-liquoring the skins and dyeing afterwards, also by pouring the dye liquor and the fat-liquor into the drum simultaneously.

In order to get complete penetration all that is necessary is to neutralize the skins well and to prolong the drumming.

After the leather has been drummed a half hour it is advisable to add a decoction of sumac or of gambier to the bath after the fat-liquor has been exhausted by the leather and to run the drum another half hour. Where the color is added to the fat-liquor, which should be alkaline, from 2 to 4 ozs. are used for 100 lbs. of leather. If very light shades are wanted the color of the skins should be lightened by passing them through a solution of one per cent. oxalic acid, then through a solution of sugar of lead, one or two minutes in each case; and this treatment may be several times repeated if the leather requires it. Acid dyes are particularly suited for coloring light and fancy shades.

The decoction of sumac referred to above is made by steeping 6 to 8 lbs. of sumac leaves or powder with 5 gallons of hot water. If gambier is used one-half as much of it as of sumac should be used; or the liquor may be made of equal parts gambier and fustic.

Diamine Colors are of value to the dyer of chrome leather. After the skins have been neutralized and shaved the solution of diamine dye is applied, no mordant being required. After the leather has taken up the color a solution of bichromate of potash or of sulphate of copper should be poured into the drum for the purpose of setting the dye and making it faster to the action of the fat-liquor. A little salt added to the dyebath is of use in getting good shades of color. No acid is used and no retannage is necessary, and the leather should be perfectly neutral before it is colored. Diamine blacks are used successfully with logwood, the leather being dyed first with the diamine black and then with logwood. A good way to use these dyes for colors is to dye with them and then to top off with basic dye. Diamine dyes are especially useful for coloring leather that is finished dull or upon the flesh side. It is best to use acid fat-liquor upon leather colored with these dyes.

Acid Colors and Bisulphate of Soda.—One hundred pounds of leather can be nicely colored by using acid dyestuffs and bisulphate of soda as follows: The required dyestuff is dissolved in boiling water and made up to 12 gallons of liquor, which is used at 140° F. After the leather has been drummed twenty minutes, 8 ozs. of bisulphate of soda are dissolved in hot water and added to the contents of the drum; drumming is continued for ten minutes, when all the dyestuff will have been absorbed. The leather is then rinsed with warm water and, if not previously fat-liquored, is fat-liquored. It is generally best to fat-liquor before coloring with this process. Complete penetration is obtained by adding 2½ ozs. of ammonia to the dyebath and drumming one-half hour longer before adding the bisulphate of soda. When this is done the quantity of soda should be increased slightly to neutralize the ammonia.

Coloring with Phosphine Dyestuff.—Tans and browns of good color and penetration are obtained on chrome sheepskins by the use of phosphines and titanium-potassium oxalate. The instructions for 100 lbs. of leather are as follows: Drum for ten minutes with a solution of 3 ozs. of titanium-potassium oxalate. Then pour into the drum 1 lb. of fustic crystals in solution and let the leather drum ten minutes. Then add 3 ozs. more of the titanium salt and drum ten minutes. Rinse the leather, drain it, and color it the shade desired with phosphine dye shaded with brown, from 2 to 16 ozs. of the phosphine and from 1 to 4 ozs. of brown according to shade desired. Fat-liquor after dyeing with a slightly alkaline fat-liquor, and finish as usual.

Fustic and Logwood Mordant.—A mixture of 2 lbs. of fustic extract and 2 to 3 ozs. of logwood crystals produces excellent results as a mordant for acid colors. After the desired shade has been secured, the skins are drained off and fat-liquored either with acid fat-liquor or with an emulsion of oil and egg-yolk. Topping acid colors with basic dye is one of the most approved methods of getting tan and golden-brown shades. Formic acid added toward the end of the process increases the depth of color and fastens the color upon the leather.

Sumac and Acid Color Mordant.—Full, rich shades of tan and brown can be secured by using the following process: Drum the skins in a solution of 2 lbs. of sumac extract and 6 ozs. of acid brown aniline for twenty minutes. Then dissolve in a little hot water 5 ozs. of titanium-potassium oxalate and pour the solution into the drum and run the drum ten minutes. Wash the skins in two changes of water and color them with basic dyes.

Practical Formulas for Popular Shades:—1. *Dark Tan.*—For 100 lbs. of leather. Drum thirty minutes with 1¼ lbs. of Chrome Fast Phosphine B. M. R. (Cassella), at 120° F. Then add 5 lbs fustic extract in solution at 120° F. and drum thirty minutes. Finally pour into the drum 2 ozs. of bichromate of potash at 120° F. and drum twenty minutes longer. Fat-liquor, set out and dry the leather.

2. A rich shade of chocolate brown is obtained by the use of aniline dyes on a tannin mordant in the following manner: Boil until dissolved 2 lbs. of gambier and 1 lb. of extract of fustic in 4 gallons of water, cool down with cold water to make 12 gallons of liquor. Drum 100 lbs. of skins with this liquor thirty minutes; then pour into the drum 4 ozs. of titanium-potassum oxalate dissolved in hot water and drum the skins fifteen minutes longer. If the mordant has been taken up by the leather, run the liquor off and run the dye solution into the drum; if it has not been taken up it is best to wash the skins before giving them the dye. For 6 dozen skins use 8 ozs. of yellow 849 and drum the skins ten minutes; then add 1 lb. chocolate brown 270 (Atteaux), 8 ozs. Bismark brown, 8 ozs. chocolate brown O, dissolved all together and poured into the drum. Run the drum twenty minutes after the color has been put in; then wash and fat-liquor the skins and hang them up to dry. Extract of sumac may be used for the mordant if preferred.

3. Golden-rod yellow, Bismark brown and champagne colors are valuable in dyeing chrome-tanned skins. A combination of golden-rod yellow and blue and brown produces a fine shade of tan. Mordant the skins with gambier and fustic, then apply titanium salt; then wash them and dye them with 20 ozs. golden-rod yellow, 8 ozs. of brown aniline and 8 ozs. of blue or green aniline. Drum twenty minutes; the result is a fine, fast and uniform shade of tan.

4. An oxblood color can be secured as follows: For each dozen skins use from 4 to 6 ozs. of extract of fustic. Drum the leather with this fifteen minutes. Then add to the liquor in the drum 2 ozs. of tartar emetic for each dozen skins and drum fifteen minutes longer. Wash the skins and prepare a color bath at 120° F. Use from 2 to 3 ozs. of amaranth 3/R for each dozen skins and drum twenty minutes, then wash and fat-liquor the skins. The shade can be darkened by using 2 ozs. of the amaranth aniline and 1 oz. of chocolate brown for each dozen skins. A liquor made of fustic and peachwood extracts is an excellent mordant for wine color.

The skins are drummed in this twenty minutes; then a solution of titanium salts is run in; they are drummed ten minutes, then washed, and colored by the use of amaranth aniline to which a very small quantity of malachite green has been added.

5. Alizarine brown and yellow fustic produce a fine shade of color for gloves, linings, etc. For each 100 lbs. of leather dissolve 2 ozs. of alizarine leather brown B No. 9052 by boiling in 6 gallons of water. Add 6 gallons of cold water and use at 195° F. Drum thirty minutes. While the skins are being drummed in the alizarine dye dissolve 1 quart of extract of yellow fustic in 1 gallon of hot water and at the end of thirty minutes pour the solution into the drum and drum fifteen minutes longer. Drain off the spent liquor; wash and fat-liquor the skins.

6. To color chrome sheep a nice shade of green drum them, per dozen, with 4 ozs. extract of sumac at 110° F. Then add to the bath, for 100 lbs. of leather, 4 ozs. of titanium salt dissolved in hot water. Drum ten minutes. Drain the liquor off and color, per dozen, with 3 ozs. of either leather green special or dark green M and 1½ ozs. of amaranth 1/R. Drum the skins twenty minutes, then wash and fat-liquor them if not previously fat-liquored.

7. A dark olive-green color is wanted for some purposes. Take the skins from the shavers and for each 100 lbs. of them use 19 gallons of hot water and wash them in this fifteen minutes; then drain the drum. Pour into the drum 3 lbs. of extract of fustic dissolved in 12 gallons of hot water and run the drum thirty minutes. Then take 12 ozs. of copperas dissolved the day before and allowed to settle and the clear liquor taken off. Pour half of this liquor into the drum and at the end of fifteen minutes' drumming look at the skins. If they are dark enough wash and fat-liquor them; if not dark enough add more copperas liquor and drum fifteen minutes longer; then wash the skins thoroughly and give them the fat-liquor.

8. *Coloring after Fat-liquoring.*—Very uniform results are

obtained by coloring chrome sheepskins after they have been fat-liquored. After they have been washed and shaved, mordant them with gambier or with gambier and fustic; then fat-liquor them with acid fat-liquor or with any other good fat-liquor; then color with aniline dyes and dry them for finishing. This method of coloring is preferred by some dyers. The process can also be varied by fat-liquoring the skins first, then applying the vegetable tanning material and coloring with basic dyestuffs. Titanium oxalate may be used in the usual manner and is of much assistance in obtaining uniform colors.

The shades in most demand at present can be mixed with the following basic dyestuffs, which can be mixed with one another at will: Paraphosphines, Bismarck browns, Leather browns; Russian Red and Oxblood A and B (Cassella). For darkening the shade: Saddening Agent for basic colors, Neutral blue and Solid green crystals.

Acid colors (Cassella): Indian Yellows, Acid phosphine, Havana brown, for shades of tan and brown. For oxblood, New Red B for leather, Roccelline mixed with Havana brown or Acid phosphine J I. For saddening the shade, Saddening agent for acid colors, Naphthol Black B and Fast Acid Green B.

Flesh-Finished Chrome Sheepskins.—For some purposes sheepskins finished upon the flesh-side with a soft, velvety finish are wanted. For this class of leather skins that have defective grain are used since the value of the leather does not depend upon the quality of the grain. The leather is produced by the usual methods of chrome tanning; but instead of being finished upon the grain the skins are dressed smooth and velvety upon the flesh-side.

After the skins have been neutralized and washed they are put into a drum together with 4 gallons of water and 5 lbs. of pipe clay for 100 lbs. of leather and are drummed twenty minutes. They are then run on a wet wheel, which gives a good face to the leather. After this has been done they are run in warm water and are then colored. The coloring is done in the same manner as upon grain-finished skins. Fustic, gambier

and sumac are used as mordants for basic dyes. Wood dyes are used also, in conjunction with titanium salt. A satisfactory method of coloring is to apply acid dyestuffs in a drum. The dye liquor without acid is poured into the drum together with the skins, which are then drummed twenty minutes. Good penetration is essential on this leather and it is helpful to add to the dye liquor from 1 to 2 ozs. of ammonia. At the end of twenty or twenty-five minutes 2 parts by weight of formic acid for every 4 parts by weight of dyestuff are added to the contents of the drum to acidify the bath. A little more than this quantity of acid may be necessary to neutralize the ammonia added previously. The leather is drummed ten minutes longer. A quantity of sumac or gambier liquor added after the bath has been acidulated imparts a feeling of fulness to the skins. As a fat-liquor an emulsion of eggyolk, olive oil, castile soap and flour is especially suitable; but a less expensive liquor can be used. The skins, after coloring, are washed and then given the fat-liquor or they may be fat-liquored first and then colored.

Drying and staking are done in the usual manner. Staking on a machine should be followed by knee staking so as to get all the stretch out. The skins are then given a light run on a very fine emery-wheel and are then ready to be trimmed and sorted. If the work has been properly done the skins finish soft, evenly colored and with a smooth, velvet-like face. Finishing on fine emery removes all roughness and makes the leather soft and smooth.

If white skins are wanted, the tanning process is followed by a treatment with flour, fat-liquoring, and finishing being then proceeded with in the manner that has been described.

Coloring Chrome-tanned Sheepskins after Fat-liquoring and Drying out.—Chrome sheepskins take color exceedingly well before they have been fat-liquored and dried, but it is generally considered impracticable to dye such skins after they have been dried out. However, Mr. Chas. Lamb, an English leather expert, claims to have perfected a process of coloring the leather after it has been fat-liquored and dried, and he

describes the working of the process in the following words: "When the dry skins have been thoroughly soaked back in warm water they are ready for dyeing, this being best effected in a drum fitted with steam pipes; neither the paddle nor the tray are suitable without some appliance for keeping the dye hot. The dyeing is best carried out at a temperature of 140° F."

"The manipulation is as follows: The dye is carefully weighed out into a small wooden tub and dissolved by pouring upon it about 200 times its weight of boiling water, stirring briskly until the dye has gone into solution. Next, bisulphate of soda, equal in weight to the weight of the dyestuff, is dissolved in hot water in a separate vessel. Half of the concentrated dye solution is now added, together with the bisulphate of soda solution, to a sufficient quantity of water at 140° F. in the drum to cover the skin. The leather is entered and the drum is started. After running the goods in this dye bath fifteen minutes, the remainder of the dye solution is added and the drumming continued for thirty minutes longer or until the goods have attained the depth of shade required. The quantities of dyestuff and bisulphate of soda for each dozen skins is 8 to 10 ozs. of the former and, as stated, an equal quantity of the latter. After dyeing, the skins are washed in warm water, set out, lightly rubbed over the grain with glycerine and dried out strained on boards."

Dyeing and Fat-liquoring Chrome Sheepskins after Drying out from the Chrome Tannage.—A process of drying chrome-tanned skins immediately after the tannage is completed, keeping them in the dry or crust condition as long as it is desired to do so, and then coloring and fat-liquoring them, is described by the inventor, Robert W. Griffith, in the Shoe and Leather Reporter:

"The goods on being taken out of the tan bath are horsed up over night without being washed and the next day are set out and shaved and weighed. A bath is prepared in a drum with 4 lbs. of standard lactic acid for every 100 lbs. of wet leather and 12 gallons of water. The goods are run in this

bath ten minutes; they are then taken out and sent to the drying loft and allowed to dry out. After drying the leather can be stored away until wanted and can then be sorted into suitable grades as required. The dry leather when treated in the manner described absorbs water readily and assumes its original wet condition the same as it came from the tan bath. It can, at this stage, be washed thoroughly without fear of injuring its character by the removal of desirable tanning salts."

"The operations of dyeing and fat-liquoring can be immediately proceeded with, and because of the even absorption of moisture by the leather these processes proceed very uniformly and are consequently facilitated. After the skins are set out from the fat-liquors they can be tacked out at once, a process which yields a considerable gain in the measurement without affecting the character of the leather. A suitable strength of the bath for experiments is one-third of standard lactic acid and two-thirds water."

The quality of the leather, it is claimed, is much improved by this treatment. The process has been patented by the inventor.

White Chrome-tanned Sheepskins.—For some purposes, such as suspender trimmings, baseball covers, linings, etc., a soft, white leather is wanted. The alum tannage can be used; there are also special tannages that produce such leather. It is also practicable to take chrome-tanned skins and by a treatment with flour and bleaching with borax and acid to finish them into soft, white leather. The tannage is the same as for any other chrome leather. After the leather is fully tanned it is washed and bleached. For each 100 lbs. of skins use 1 lb. of borax or bleaching soda dissolved in hot water and wash the skins twenty minutes. Then drain out the water, replace the plug and put into the drum cold water to which some sulphuric acid has been added, and drum the leather with it thirty minutes. The borax opens and softens the skins and prevents the acids from doing injury. After the leather has been washed in the acid solution it should be washed in clean

hot water and shaved. The next process is the treatment with flour, 50 lbs. of flour being used for 100 large skins or 200 small ones. The flour is stirred into 10 or 12 gallons of water for 100 lbs. of skins and the leather is drummed in the liquor two hours; it is then struck out and pressed and given some fat-liquor. For some purposes the skins work out sufficiently white without the borax and acid treatment. Sulphonated oil dissolved in warm water is excellent fat-liquor for these skins.

When the leather is dry it is moistened and staked, then run in a clean dry drum with powdered chalk or soapstone an hour and then arm-staked. Chrome skins in the natural greenish-blue color of the process are obtained by simply washing, shaving and fat-liquoring them; then drying, staking and tacking onto boards.

The Finishing of Chrome-tanned Sheepskins.

After chrome-tanned sheepskins have been dyed and fat-liquored they are struck out and the grain is oiled lightly with a mixture of 1 part neatsfoot oil and 3 parts paraffin oil for glazed finish, and equal parts neatsfoot and paraffin oils for dull finish. Care must be taken to not give the skins too much fat-liquor and oil and thus make them too soft and spongy. The skins, after the grain has been oiled, are hung up to dry. The best results are obtained from rather slow drying in a room with a temperature of about 80° F., and having a good circulation of air.

When dry the skins are dampened and staked. A satisfactory way to dampen them is to have a tub two-thirds-full of warm water and to put about a dozen skins into the water at a time, leaving them two or three minutes therein, then placing them in a pile, well covered, on the floor or in a box. When they have become pliable they are staked and restaked, and then tacked on boards to dry. When thoroughly dry they are taken off the boards, trimmed and prepared for the work of finishing.

Black Glazed Finish.—Where the grain of the leather is greasy it is advisable to apply to it a dilute solution of acid to

clear it. Either lactic or formic acid may be used. The acid, diluted with water, is rubbed into the grain and the leather dried. When dry, the grain should be rubbed with a soft cloth and then be given the first coat of seasoning or finishing ink. The acid assists in getting a clear, bright finish.

1. An excellent seasoning for black-glazed finish is made of the following ingredients: Ivory soap, 1 lb.; glue, 1 lb.; logwood crystals, 3 ozs.; nigrosine, 4 ozs.; bichromate of potash, ½ oz.; fresh beef blood, 2 quarts.

Dissolve the soap in 8 gallons of boiling water and the glue also in 8 gallons of water. Dissolve the logwood and nigrosine in 2 gallons of hot water and add the bichromate of potash; when cold add the blood. Take 1 quart of the glue solution and 1 quart of soap solution and mix into the logwood and blood solution. Stir the mixture well and strain it. Rub a light coat of this seasoning into the grain of the leather. Dry in a warm room and glaze. Apply a second coat of seasoning, dry and glaze again. Finally, after the finish has aged a little, oil it very lightly with warm finishing oil or with a mixture of equal parts of neatsfoot and paraffine oils.

2. The following formula also produces an excellent seasoning for glazed finish: Whole flaxseed, 2 ozs.; logwood crystals, 2 ozs.; nigrosine, 2 ozs.; bichromate of potash, ½ oz.; vinette, ½ oz.; blood, 1 quart; glycerine, ½ pint; carbolic acid crystals, 1 oz.

Boil the flaxseed thirty minutes in 1 gallon of water; then strain the solution and add the logwood, nigrosine and potash and boil up again; then cool the solution to 90° F. and stir into it the vinette, blood, glycerine and carbolic acid. There should be 2 gallons of seasoning. If there is less, add enough cold water to make the quantity specified. Apply the dressing to the skins, dry and glaze in the usual manner.

3. Another formula for glazed finish is: Blood albumen, 1 lb.; black nigrosine, 5 ozs.; logwood crystals, 1 oz.; wood alcohol, 1 gill.

Dissolve the blood albumen in 1 quart of water over night. Boil the nigrosine and logwood in 3 gallons of water. When

the solution is cold add the albumen and wood alcohol. Give the skins two coats of this seasoning, and glaze them twice.

When the grain of the leather is greasy it is of benefit to rub into it a solution of wood alcohol and black nigrosine. Dissolve 1 oz. of nigrosine in 1 gallon of water and add to this a little wood alcohol. Rub this into the grain of the skins and when it is dry apply the seasoning. The black is deepened by this treatment and the grain is cleared.

A solution of oil-soluble black aniline in benzine is of use in touching up spots that are not a good black.

4. A kid finish on black sheepskins can be secured by the use of the following seasoning: Logwood liquor, 6 quarts; beef blood, 2 quarts; orchil, ½ pint; water, 1 quart; ammonia, ¼ pint; milk, ½ pint.

There are excellent seasonings on the market that can be bought ready for use. The tanner can buy them and dispense with the labor of making his own finishes. This is done by many, who find it convenient and advantageous.

Seasoning for Dull Finish.—Ivory soap, 1 lb.; flaxseed, ½ lb.; beeswax, 4 ozs.; black nigrosine, 4 ozs.; gelatine, 4 ozs.; aloes, 2 ozs.; wood alcohol, ½ pint. Put the soap, flaxseed and beeswax into 2 gallons of water and boil thirty minutes, then add the nigrosine. Dissolve the gelatine in 1 quart of water and add to the solution. Then dissolve the aloes in the wood alcohol, add to the other solution and strain the mixture. Apply a coat of this dressing to the grain of the leather, rubbing it in well. When it is dry, iron the leather, and then give it a second application of the dressing; but do not iron it again. As a finishing touch oil the grain with paraffine oil.

Seasoning for Colored Sheepskins.—1. A clear, bright finish is obtained on colored sheepskins by using a seasoning made of egg-albumen solution, acetic acid, bichromate of potash and water. The quantities are 4 gallons of egg-albumen solution, 1 oz. of bichromate of potash, 2 quarts of acetic acid and 20 gallons of water. The ingredients should be mixed thoroughly. The seasoning should be applied sparingly so that the grain and wool pits will show when the leather is glazed.

2. A solution of vinegar 1 part and 12 parts water and a little bichromate of potash is useful in clearing the grain for colored glazed finish.

Another formula for a seasoning similar to No. 1 is: Egg albumen, 12 pints; bichromate of potash, 1¼ oz.; acetic acid, 10 ozs.; water, 5 gallons.

Dissolve the albumen and mix all together; then add one teaspoonful of sperm oil and 3 pints more of water. Rub the finish in well, dry and glaze. For second seasoning use: Blood, 3 gallons; water, 5 gallons; vinette, 2 pints. Apply a coat of this to the glazed leather, dry and glaze again, and the leather is finished.

Degreasing Sheepskins.—Much of the natural grease in sheepskins can be removed by pressing in a hydraulic press previous to tanning, or while the goods are in the limed or the pickled condition, preferably the latter. The pressure applied is very great and large quantities of grease are removed in this way. Pressing before tanning is always advisable and yet this method is not always as effectual as might be desired. Treatment with naphtha in liquid or gaseous form is often resorted to. This method of degreasing usually removes every particle of grease and oil from the leather. It is used after the tanned skins have been dried and before they are finished. The work of degreasing with naphtha should be done in a building apart from the main factory and no fire or artificial light should be allowed near the naphtha vats.

The skins are immersed in the naphtha in a tank or closed vessel or drum which either revolves, or in which they can be stirred or otherwise agitated so as to insure rapid and thorough permeation of the naphtha. By processing the greasy leather in this manner the liquid becomes so thoroughly saturated with the oily matter extracted that it will take up no more. If one bath is not sufficient to extract all the grease the skins are removed to a fresh bath. They may be subjected to a fresh supply of naphtha again and again until the liquid in which they are last placed remains pure and shows no trace of oil or grease. The action of the naphtha is quite harmless and no

strength of the leather is lost by this treatment. The leather can be degreased by soaking it in the fluid for several hours and then pressing out the naphtha with a slicker. On a small scale the work can be done by throwing the skins in loosely and separately and stirring them about for an hour or two. Light skins show a difference after they have been in the liquid a half-hour. When they seem sufficiently degreased they should be taken from the naphtha, pressed out with a slicker and then hung up until the naphtha is entirely evaporated.

When an unsuitable oil has been used upon leather it is sometimes necessary to purify the leather from the gummy matters that have resisted the action of the naphtha. In such cases a drenching with alcohol, wood-spirit, ammonia or some other solvent is required. After this treatment the leather is dried and finished in the usual way, and when it is glazed it is unusually bright and clear and the fibers are soft and strong.

The Leather Trades Review says: "Leather is degreased by treatment with volatile solvents, which have the power of dissolving the contained grease. The common method of degreasing is to hang the goods in a closed chamber, into which the vapor of light petroleum-ether or benzine is allowed to enter, the benzine or petroleum-ether completely dissolving the grease. The solvent condenses on the leather and a liquid then exudes which flows to the bottom of the chamber and is run away into a distilling plant placed in close proximity, by which the solvent is recovered, to again, in the form of vapor, pass into the chamber. In this way the goods are subjected to a continuous current of the solvent, and they are allowed to hang in the chamber until every particle of grease has been extracted." Sheepskin fat is soluble in hot alcohol, ether, chloroform, petroleum-ether, commercial benzoline and naphtha, and all of these mediums are used for degreasing tanned leather.

A method of degreasing followed out in Buenos Ayres is as follows: The pelts, dewooled by sweating, are put into the degreasing apparatus, which consists of a metal drum coated

with zinc and which can be hermetically closed. To the skins, which are in wet condition, the degreasing liquor is added. This consists of benzoline and methyl alcohol. The latter is used because the skins are wet and the benzoline, which does not mix with water, would not penetrate the skin and neutralize the grease. The alcohol is the medium to assist in mixing the water and benzoline and insures the desired effect on the wet skin.

After the skins have been in the drum for an hour and a half they are taken out and pressed quickly, and most of the grease comes away in liquid form. The mass pressed out can by distillation be reworked and the degreasing materials recovered with a loss of about 30 per cent. The skins are soaked in water and thrown into the lime and worked in the usual manner.

The ordinary purposes of the above method could be modified as follows: The dewooled skins, after soaking and liming, may be reduced in the paddle vat by lukewarm water and thoroughly stretched on the Vaughn machine, and after this put into the extraction apparatus. This operation is succeeded by pressing and a treatment in a drench or bate. If the skins are not too greasy a second putting through the machine would be an improvement. After vegetable-tanned skins have been degreased it is generally necessary to retan them, as the tannage of greasy skins comes out easily. The best material for retanning is one that tans mildly without making the leather loose and spongy and at the same time giving the leather a nice light color. Sumac is undoubtedly the best material for the purpose. The liquor may be made 2° or 3° Baumé and the skins should be drummed with it two or three hours, according to their weight, then dried and finished. Benzine to which some acetone has been added is often used for degreasing tanned skins, the solvent being recovered for subsequent use.

Alum Tannages for Pickled Sheepskins.—1. Soft and well-tanned skins are obtained by tanning with sulphate of alumina and salt, eggyolk and olive oil. Flour is used also to impart

fullness to the skins. One hundred pounds of pickled skins can be tanned with 3 lbs of sulphate of alumina, 2 lbs. of salt, 5 lbs. of flour, 1½ lbs. of alumina, 2 lbs. of eggyolk and 1 lb. of olive oil.

The flour is made into a paste with cold water. The sulphate of alumina and salt are dissolved in a few gallons of water, and to the solution 4 ozs. of bicarbonate of soda are added, and then the eggyolk and olive oil stirred in. Finally flour paste is added and the skins are drummed with the mixture two hours, left in over night and then hung up to dry. When dry they should be left in a clean, dry room for some weeks before they are finished. They are then staked and buffed and drummed with 1 lb. of eggyolk and 5 lbs. of French chalk, set out, tacked and dried. The foregoing formula is used and recommended by the tannery school of Pratt Institute, Brooklyn, N. Y. The skins can be finished white, or colored any desired shade. Delicate shades are obtained by using wood dyestuffs combined with some subdued aniline dye. Special glove dyes are also procurable especially suitable for alum-tanned skins.

The skins can be tanned with the sulphate of alumina and salt without the eggyolk, oil and flour, dried out and kept an indefinite length of time, improving with age. They can then be made into excellent chrome leather by being washed back and tanned with one-bath chrome liquor.

2. Another good formula that produces nice white, soft and well-fed leather is as follows: For one dozen skins, 1 lb. of alum, 1 lb. of salt, ¾ pint of eggyolk and 1 lb. of flour are used. The alum and salt are dissolved in hot water. The flour is mixed with cold water and the eggyolk is added and the whole thoroughly stirred. The solution of alum and salt and the mixture of eggyolk and flour are put into the drum together with the skins and the latter drummed for two hours. The skins are left in the liquor over night, then dried out. One to two gallons of warm water are used with the tanning materials for one dozen skins. This tannage should not be used upon skins in the pickled condition. If such skins are to

be tanned with it the pickle should be removed by a light sour drench of bran and salt.

3. One dozen small lambskins for glove leather can be tanned with ¾ lb. of alum and ½ lb. of salt. Dissolve the alum and salt together, making a half pail of liquor for one dozen skins. Drum the skins with this solution for half an hour; then add one pail of good flour to each 10 or 12 dozen skins and 1 quart of eggyolk. Run the drum a half-hour longer, then hang the skins up to dry. After drying lay away for a while to age. Next dampen the skins and drum with a little flour, then knee-stake them, wash them and give them two quarts of eggyolk to twelve dozen skins. Dry again, stake and finish. The skins should be taken from the drench and tanned without pickling. If pickled, drench them in a drench of sour bran to remove the acid.

4. Sheepskins taken from the drench or depickled in a bath of sour bran and salt can be alum-tanned in the following manner: For every 100 lbs. of skins, 3 lbs. of sulphate of alumina and 6 lbs. of salt are dissolved in 6 gallons of water. This liquid is put into the drum with the skins and the drum is run thirty minutes. A solution of 10 lbs. of hyposulphite of soda in 5 gallons of warm water is poured into the drum and the skins are drummed in the combined solutions for twenty minutes. The hyposulphite of soda fixes the tannage upon the fibers of the skins, and also thins the goods. In order to overcome the thinning of the skins another solution of 2 lbs. of sulphate of alumina and 4 lbs. of salt in 3 gallons of water is added to the contents of the drum and the drumming is continued for another half-hour or until the skins have become plump. The next operation is rinsing in clean water and allowing the leather to drain several hours, then drying it out. Skins of fine texture and grain are obtained by this process. It is very essential, however, that the skins be entirely free from acid and perfectly neutral when the process is begun, otherwise they will be imperfectly tanned. After the skins have dried they may be made softer by drumming in a warm solution of sulphonated oil. Flour may be added

to the oil. The leather can also be washed back and tanned with a one-bath chrome liquor and finished in any manner desired. White chrome leather is secured by bleaching the skins with borax and sulphuric acid and fat-liquoring with sulphonated oil and flour.

Alum-tanned skins should be buffed on the flesh side on an emery-wheel to get rid of all loose flesh and to make them soft and smooth. Flour in any alum process increases the softness and plumpness of the skins and makes the grain less liable to crack. The cost of tanning is of course increased by using flour, but the better quality of the leather is sufficient to offset the added expense.

5. For soft white leather that is suitable for any purpose for which such material is required, tanning with sulphate of alumina and bicarbonate of soda in the following manner will be found a satisfactory process. The skins, pickled and degreased as thoroughly as possible, are thrown into a drum together with 10 gallons of water, 3 lbs. of salt and 1 lb. of Glauber's salt for 100 lbs. of goods. Drum fifteen minutes, then drain. Next put into the drum 10 gallons of lukewarm water and 4 lbs. of salt and drum it 10 minutes. The tanning liquor should be prepared the day before it is to be used. Boil 12 lbs. of sulphate of alumina in 10 gallons of water. Also boil in a clean pail 1½ lbs. of bicarbonate of soda. Pour the soda solution slowly and whilst constantly stirring into the alumina liquor, allowing intervals for the effervescence to subside. After the skins have been running in the salt water ten minutes, pour into the drum half of the alumina-soda liquor and drum for three hours; then horse the skins up smoothly over night and the next day hang them up to dry.

When they are dry put the skins back into the drum with 8 gallons of water and drum ten minutes; then pour into the drum the rest of the alumina and soda liquor and drum the skins three hours, more or less, according to their thickness. Drain and hang up to dry.

For some purposes the skins will be found sufficiently soft; but if softer leather is wanted, dampen the skins with water

and fat-liquor them with sulphonated oil, from 3 to 6 lbs. of the oil, according to the degree of softness desired. Dissolve the oil in 8 gallons of warm water; drum the skins thirty minutes; then set them out and apply to the grain a solution of 2 parts of glycerine and 4 parts water, to which French chalk has been added. Dry, stake, tack on boards and buff the flesh if it needs it.

The skins after they have been dried from the tannage can be wet back and retanned with chrome liquor and finished into chrome leather.

Depickling.—The acid pickle can be removed in a bath of whiting and salt. For 10 dozen skins use 4 lbs. of whiting and 24 quarts of salt in water at 90° F. Drum the skins in this bath twenty minutes, then let them remain in the bath an hour, and then throw them into a light sour bran drench for half an hour, adding salt to keep them from swelling. Finally wash them in warm salt water to remove every trace of whiting and bran. Plenty of salt must be used to keep the skins from swelling, and precaution must be taken to wash all the whiting from the skins or they will be harsh and brittle after tanning.

6. 100 lbs of depickled skins can be tanned with a tanning paste composed of 9 lbs. of alum, 6 lbs. of salt, 20 lbs. of flour. Use at 90° F., and drum the skins one or two hours, then dry them out. Dampen and stake and fat-liquor with sulphonated oil or add eggyolk to the tanning paste.

Coloring.—Alum-tanned leather is as a rule dyed with wood colors which may be shaded with acid dyes; another way is to bottom with wood colors and then to top with basic dyes. The wood dyes are the more durable, but the aniline dyes are the more easily applied. A mordant is not necessary as the alum itself acts as a mordant and the color adheres readily to the alum-tanned fibers. Wood-color extracts in crystal form dissolve readily in boiling water and give nice, clean shades of color on alum-tanned skins. It is necessary to thoroughly wash the dry skins before coloring them. This is done by washing them in warm water in a drum, giving three changes

of water and adding a small quantity of carbonate of ammonia to the second water, say 2 per cent. on the weight of the skins. The washing consumes about one hour and the temperature of the water should be about 85° F. Some skins require more washing than others. A polygonal drum is very useful in washing and coloring any kind of leather. When the washing is completed and most of the tanning dressing has been removed the skins are colored. When a white flesh and colored grain are wanted the dye is applied to the grain side only by means of a brush or a sponge. Coloring in a drum dyes both flesh and grain sides.

After the leather has been colored it is given a nourishment to make up for the tanning material lost by washing and coloring. This is a retannage of alum, salt, flour and eggyolk, which may be worked in mechanically or the skins may be kneaded in the mixture.

Sulphonated oil may be added to the paste in place of eggyolk. For black skins logwood and striker are used. The skins are then given the retannage or nourishment and are then dried and finished. Shades of tan are secured by first drumming the skins in a bath of $1\frac{1}{2}$ per cent bichromate of potash for 20 minutes; the liquor is drained off and a new bath of gambier added and the skins drummed thirty minutes. Wood dyes such as Cuba wood, fustic, Brazil wood and logwood are next applied and the color developed with titanium-potassium oxalate. The right shade can also be obtained by applying basic color to the wood-dyed bottom, then retanning the skins and finishing them.

Coloring with Natural Dyestuffs.—The following recipes for dyeing tawed leather with natural coloring matters are taken from an article in the "Shoe and Leather Reporter." They may prove of interest and value because of the scarcity and high cost of synthetic or artificial dyestuffs at the present time.

Camel-brown.—Boil 2 lbs. of oak tan, 2 ozs. of sumac, 1 oz. of Brazil wood and some onion peelings in water. Apply warm by brushing on.

Chestnut-brown.—Boil 1 lb. of ground logwood, 2 lbs. of

ground Brazil wood, 1 lb. of rasped fustic and 4 ozs. of gallnuts in water.

Coffee-brown.—2 lbs. of ground oak tan, 1 lb. of rasped fustic and a little soda lye are boiled in water. Then boil 1¼ ozs. of Brazil wood and 1 oz. of rasped logwood in water, adding this second decoction slowly to the first one until the liquor has assumed a brown color; then add a little copperas dissolved in warm water, which darkens the shade and acts as a striker.

Flesh color.—Boil 4 ozs. of bruised Avignon berries and 25 grains of potash; then add gradually a decoction of Brazil wood until the desired tint is obtained.

Green.—For this color boil 10 lbs. of rasped fustic, 2 lbs. of logwood, ½ lb. of ground gallnuts, and 3 ozs. of sulphate of copper; or buckthorn berries may be used for the yellow.

Another recipe for green is: 1 lb. of logwood, 1 oz. each of onion peeling cut up and rasped fustic and 2 ozs. of alum; boiling for 2 hours in 6 quarts of water.

Lilac.—Boil for two hours, 12 ozs. of logwood, a little lime and alum, then add 2 or 3 ozs. of Brazil wood and boil for another ten minutes.

Olive green.—Boil fustic and some bruised gallnuts in water, then sadden with a solution of copperas until the desired shade is obtained.

Rose color.—This is obtained by boiling for an hour, 15 grains of cochineal ground fine, in 1 pint of water, then add ¼ ounce of logwood and 6 drops of spirits of salts.

Violet dye is made by mixing 8 parts of rasped logwood with 2 parts of Brazil wood, boiling up in 40 parts of water with 1 part of alum.

Dark yellow.—Boil up in water 8 ozs. ground Avignon berries, ½ oz. of potash and 1 oz. of fustic. For light yellow, substitute quercitron for the berries.

Azure blue on kid leather may be secured by dissolving 2 ozs. of prussiate of potash in 6 quarts of tepid water. Brush this over the skin until it is well permeated, then give a light coat of very dilute iron liquor.

Black dye is made by boiling 3 lbs. of logwood with 8 ozs. of fustic in 6 quarts of water. Filter; apply the liquor to the leather, then when nearly dry give a wash of copperas dissolved in water. An oil dressing is then usually applied to the grain side of the leather.

Brown.—For brown, take 25 parts of willow bark, 8 parts of elder bark, 1 part of logwood and ½ part of indigo carmine. If the bark of willow is boiled with a strong solution of copperas it furnishes a shade known as English grey, while many variations in shade can be secured by modifying the ingredients. For example, a grey-brown is produced by extracting together with boiling water 35 parts willow bark, 2 parts elderberries and ½ part of Brazil wood. A grey-green by mixing 3 parts willow bark, 4 parts fustic and ½ part of logwood.

Tanning with Formaldehyde.—The first really practical process of tanning with formaldehyde was published by Eitner, a German chemist, in 1899. According to his instructions, sheepskins, after the usual beamhouse work, are treated for 24 hours in a liquor made from ½ part of commercial formaldehyde with 100 parts of water. On coming from this bath the skins present an acid reaction, and they must be neutralized with a weak alkaline solution such as carbonate of soda, borax, phosphate of soda, but better still, with a mixture of ammonium sulphate and carbonate of soda. Finally the skins are washed in clean water for forty minutes, withdrawn and allowed to drip on a horse.

They are then fat-liquored with a fat-liquor made with 100 parts of neatsfoot oil, 25 parts of carbonate of soda and 500 parts of water. The skins are turned in this liquor one hour.

A product is thus obtained which is very supple and closely resembles alum-tanned leather. It is of the nature of ordinary alum-tanned leather rather than of the glazed variety, the fullness of which it does not possess. Nevertheless the grain is fuller and more brilliant than a simple alum-tanned leather. If the flesh side is passed over an emery wheel it very much resembles the velvety appearance of chamois

leather. If to the soap fat-liquor a little moellon of first quality be added, skins of yellow color and extremely supple are obtained, which can be bleached by the same processes as are used for chamois leather. Neatsfoot oil and clear cod oil produce white skins. For a sheepskin of average weight 60 to 70 grammes of grease are necessary.

Finishing is carried out by smoothing, staking, dyeing as for ordinary chamois leather. If the skins are to be dyed they are treated like chamois rather than like alum leather. Formaldehyde leather may also be treated like mocha glove leather, which is finished on the grain side, the grain, however, being buffed off by means of emery or carborundum. In carrying out this work carefully a surface is obtained which is not a grain and which has the characteristic feel of velvet. In formaldehyde tannage the grain of the skins has a slightly hard appearance. If the grain is buffed off as described this harshness is completely removed and a very fine leather is obtained.

The preparation of the skins may be carried out in two ways. In the first method, after the skins have been well scudded and bated, they are placed in a ½ per cent. solution of formaldehyde and left for 12 hours, then neutralized, washed in pure water and fat-liquored with a mixture of 2 parts of neatsfoot oil and 1 part of good moellon. The skins are dried, fluffed by carborundum in order to give them a velvety and regular appearance.

In the second method the skins are first treated in the bate and afterwards immersed in the ½ per cent. solution of formaldehyde, but only for one or two hours, and after this, they are tawed in the ordinary fashion for glazed skins, and the finishing processes are the same.

In dyeing the skins obtained by the first of these two methods, the processes commonly employed for chamois leather may be used, in which the skins receive, after dyeing, a light fat-liquoring in the form of a little moellon. In this way skins are obtained that are useful for belts, lithography, etc.

The formaldehyde tannage of sheepskins can also be carried

out as follows: For each 100 parts of pelt, dissolve 1 part of formaldehyde *i. e.* about 2½ parts of commercial formaldehyde in a convenient quantity of water so that the process can be carried out in a paddle. The skins are left twenty-four hours in the paddle, then withdrawn, neutralized, washed and fat-liquored, the latter consisting of 3 parts of soft soap in sixty parts of water. Skins are thus obtained which are very similar to alum-tanned goods. They have a white section, present a very fine grain, but they stretch a little less than glazed skins. If the skins are desired slightly yellow, similar to chamois skins, instead of fat-liquoring with soap, moellon should be used, which also gives to the skins the characteristic odor of cod oil.

When skins are being tanned with the grain removed a formaldehyde tannage can be carried out much more easily, since there is no compact grain to resist the penetration of the formaldehyde. In this case a 1 per cent. solution can be used. This quantity is added in two portions, and fat-liquoring is carried out with 6 parts of soft soap. This sort of leather can be very satisfactorily employed for fancy belts, pocket-books, lithographic rollers, morocco leather manufacture and other fancy articles.

Nappa Leather for Gloves and Mittens.

Nappa leather is at the present time made by a chrome process. The skins are first tawed with alum or sulphate of alumina, dried and then retanned with the chrome liquor. The resulting leather is very soft and durable. The colors are usually tans and browns, and these are obtained by dyeing with acid and basic dyestuffs; the anthracene yellows and anthracene chromate browns being especially suitable for this kind of leather.

The pickled skins, after they have been pressed for removal of the grease, can be tanned in a drum with 3 lbs. of sulphate of alumina, 2 lbs. of salt and 4 ozs. of bicarbonate of soda. The sulphate of alumina and salt are dissolved in 5 gallons of boiling water and the soda, also in solution, is

slowly stirred into the liquor. Cold water is then added to make 12 gallons of liquor and the skins are drummed in it two hours, left in the liquor over night, and then dried in a warm room.

Instead of the above tannage any alum tannage can be used. The skins can be well tanned with alum and salt, but in this case it is best to depickle them before treating them with alum tannage. The alum-tanned skins, after they have been in the dry condition some time are well washed in tepid water and then subjected to the chrome tannage. Any one-bath tannage can be used. The tanner can buy the chrome material or he can prepare the liquor himself. For instance, the following formula can be used: 8 lbs. of chrome alum dissolved in 10 gallons of water for 100 lbs. of wet leather.

The skins are drummed in this solution one hour. A solution of 1¼ lbs. of soda ash or 3 lbs. of soda crystals diluted with ½ lb. 40 per cent formaldehyde is then gradually added to the liquor in the drum and the leather is drummed another hour or two; it is next placed on horses for twenty-four hours, then neutralized and washed in the usual manner and fat-liquored. Another excellent formula for the chrome liquor is as follows: 10 lbs. of bichromate of soda are dissolved in 2 gallons of water and to the solution 10 lbs. of sulphuric acid are added. 6 lbs. of syrup glucose are then slowly added in several portions to the liquor, time being allowed for the agitation to subside between the additions. This liquor when diluted to 45 Bé. is ready for use, 15 lbs. of it being required to tan 100 lbs. of skins. It is advisable to add some salt to the liquor and to let the leather press and drain from twelve to twenty-four hours before washing it.

The two-bath method of tanning the skins is as follows: For each 100 lbs. of skins use 6 pounds of bichromate of soda, 4 lbs. of salt, 3 lbs. of muriatic acid and 15 gallons of water. Throw the skins into the drum and set in motion. Pour the prepared solution into the drum and let the goods drum from one to two hours, then horse up over night. The next morning prepare a 10 per cent. solution of bisulphate of soda and

dip the skins one at a time into this solution, then throw them into the drum. Add 12 lbs. of hyposulphite of soda in solution to 12 gallons of water, then put in 3 lbs. of salt, and to the liquor add slowly 6 lbs. of muriatic acid and drum the skins in this from one to two hours. Drain from twelve to twenty-four hours, neutralize and wash as usual.

Tanolin or any other one-bath chrome material can be used with satisfactory results. The fat-liquoring is done with any good chrome leather fat-liquor, such as 1 lb. of olive oil soap, 1½ ozs. borax, 8 ozs. of neatsfoot oil and 1½ lbs. of eggyolk for 100 lbs. of leather. Or the following:

Eggyolk, 1 pint; flour, 1 pint; olive or neatsfoot oil, ½ pint; Castile soap, 4 ozs.; water, 6 gallons, for each dozen skins. Chip the soap into the water, boil until dissolved and stir in the oil. Boil the mixture of soap and oil; cool down to 110° F. and add the eggyolk. Mix the flour into a thin paste with cold water and add to it the soap, oil and egg mixture. Use at 110° F. Commercial fat-liquors are also suitable for this leather. Directions for their use are furnished by the manufacturers.

The leather prepared in this manner withstands heat very well and may be dyed without being impaired at a temperture of 175° F., which temperature is requisite for imparting a high degree of fastness to the dyeings.

The coloring is carried out best in a drum heated by steam or else in the ordinary drum. The Cassella Anthracene Yellows and Chromate Browns are used in the following manner: The leather is thrown into the drum and the solution of dyestuff at 120° F. and containing 1 per cent. ammonia is poured in and the drum is run fifteen minutes. A solution of formic acid well diluted and bichromate of potash is then added to the liquor in the drum. The temperature is raised by steam to 170° F., and the goods are drummed at this temperature for fifteen minutes. Then the liquor is allowed to cool down to 120° F., when 5 per cent. gambier is added, and this is absorbed by the leather in another half-hour's drumming. Finally the skins are rinsed in warm water, set out, dried out and dressed in the customary manner.

The Anthracene Yellows and Anthracene Chromate Browns can be combined with each other to produce any desired shade. Yellow glove and mitten leather is obtained by coloring with gambier, picric acid and fustic. Boil 25 lbs. of gambier in a barrel three-fourths full of water. To this solution add 1 pint of muriate of tin and 3 ozs. of tin crystals and fill the barrel with water. To color 100 skins use from 6 to 10 gallons of this gambier liquor at 90° F. and 4 gallons of water and drum the leather one-half hour.

Prepare a solution of picric acid and fustic by dissolving 8 ozs. of each in 2 gallons of boiling water, to which add 1 gallon of cold water. Pour this solution into the drum with the gambier liquor and drum the leather thirty minutes. This process of coloring may be applied either before or after fat-liquoring. Staking, drumming with powdered soapstone and staking again completes the process of manufacture, and the leather is ready for use.

Vegetable-tanned Sheepskins.

Quebracho Tannage.—Soft and well-tanned leather is made by tanning pickled skeepskins with quebracho extract. This tanning material is used alone with good results; it is also used in combination with chestnut and hemlock extracts. It is recommended that for the quebracho tannage the skins be pickled with formic acid and salt. When so pickled and carefully tanned they have fine, soft grain and there is no danger of difficulty in dyeing due to lime spots. The natural grease should be removed by pressing the skins while they are in the pickled condition. It is also practicable to press them after they have been colored in the first quebracho liquor; they are then put back into the liquor and tanned thoroughly. There should always be salt in the quebracho liquors. A quantity of the extract is boiled with water in a barrel and this forms a stock solution from which the tan liquors are made and strengthened.

To make the first liquor, add enough of the dissolved extract to water in a paddle to make a 3 or 4 degree barkometer

liquor. Let the skins turn in this liquor until they have assumed a uniform color and are well struck with the tan; then either strengthen the liquor or pass the skins into a fresh and stronger liquor of 6 or 8 degrees strength. After several hours the liquor is strengthened to 10 degrees and the skins are left therein until they are completely tanned. The skins can be taken out of the paddle after the grain is set and tanned out in a drum, thus saving time.

When it is fully tanned the leather is washed and fat-liquored with a solution of sulphonated oil or some other fat-liquor and dried, or it is dried and fat-liquored after dyeing. The skins can be tanned by being tacked onto wooden strips or frames and suspended in the liquor. The tanner must be careful to avoid drawn grain by having the liquors too strong at the beginning. The liquor for the fresh skins should not be over 6 to 8 degrees strength; but as soon as the grain is well set the liquor can be strengthened. Colored and embossed, the skins make fine leather for pocketbooks and bags, sweat-bands for hats, and for other purposes.

A good tanning process consists of starting the skins in weak hemlock liquor and then passing them into a stronger liquor composed of hemlock, oak wood and quebracho extracts, care being taken to handle the skins every day until they are tanned. Hemlock and quebracho extracts combined form a good tan for sheepskins. The liquors may be two-thirds quebracho and one-third hemlock. The resulting leather is tough, firm and pliable; it has good color which is more satisfactory in every way than the color of hemlock leather.

Hemlock Tannage.—Large quantities of sheepskins are tanned with hemlock bark extract, and applied to various purposes. The tannage fills and plumps the skins and the leather has good color on which it is easy to apply aniline dyes. Hemlock-tanned skins are finished in the natural color of the tan; they are dyed black or colored and finished with a smooth or an embossed grain for fancy leather purposes.

Pickled skins should be pressed for removal of the grease and drummed in warm salt water to soften and open them

out and to separate them and prepare them for the tannage. There should be considerable salt in the liquors. The tanning is begun in weak liquor, which is gradually strengthened until the skins are tanned through. When tanned the leather is horsed up to drain, dried, then colored and finished. A mixture of oak and hemlock liquors produces light-colored, well-tanned leather.

Combination Tannage.—A combination tannage of gambier, alum and salt can be recommended for making a soft, durable leather from sheepskins. The skins are limed and drenched in the usual manner and are then placed in gambier liquor in a paddle. From 3 to 5 lbs. of gambier is the quantity used for one dozen skins, according to their size and thickness. After the skins have begun to absorb the gambier, from 8 ozs. to 1 lb. of alum and ½ lb. of salt for each dozen skins are added to the liquor and the paddling is continued until the tannage is completed. The leather is then washed in warm water to remove the adhering tan and then fat-liquored with acid fat-liquor, dried, wet back, colored or blacked, dried again, and finished.

After the alum and salt are added it is practicable to put the skins and tanning liquor into a drum and drum a few hours or until the skins are thoroughly tanned. Some soluble oil can also be added to the liquor and applied to the leather toward the end of the tanning process. Excellent leather is also made by taking the skins out of the gambier liquor when they are well struck through, striking them out, and then drumming them in a paste of water, flour, alum, salt and either eggyolk or sulphonated oil, drying, and then coloring them with aniline dye and titanium-potassium oxalate. Quebracho extract may be used in place of gambier with equally good results. The color of the tanned leather can be greatly modified by adding a solution of fustic or other dyewood to the gambier liquor. The entire process can also be reversed. The skins can first be drummed in alum and salt, dried out and staked and then retanned with gambier. For glove leather flour and oil may be added to the alum and salt liquor, the skins drying out soft and full.

Heavy skins can be tanned with gambier, split and shaved, and then retanned with gambier, alum and salt; they can also be alum-tawed, sammied and shaved, and then retanned in a drum with gambier or quebracho. There are numerous variations of the process, these few suggestions being sufficient to give some information about methods that may be used. After the leather is dry it can be colored and, if not previously fat-liquored, drummed in acid fat-liquor or an emulsion of oil and soap, dried, staked, and finished, the result being soft, durable leather that is suitable for gloves, linings and various other purposes.

The use of sumac after the regular tanning process is complete is for the purpose of preparing the leather for coloring. When the skins are completely tanned, they are horsed up over night and are then placed in sumac liquor. This is prepared by adding water at 122° F. to 25 lbs. of best Palermo sumac. The liquor should be cooled to 90° F. before the skins are put in; and after the goods are in the liquor they should be stirred about more or less and left in over night, then drained, set out and dried. The sumacking can also be done in a drum. If soft leather is wanted the skins can be run in a solution of sulphonated oil before they are dried. When dry they should be kept in storage some time before they are colored and finished.

Well-tanned leather results from a tannage of gambier and sumac. The skins are put into a 10-degree barkometer liquor slightly acidified with acetic acid. After they have been in this liquor a few hours they are placed in another and stronger liquor; and from this they are passed into a third and still stronger liquor to which acetic acid and oak wood extract have been added. From this third liquor the skins are passed into the sumac bath, and then oiled and dried out.

The application of an alum or kid tannage to skins tanned with gambier or quebracho makes fine, soft dongola leather. For 200 average skins a mixture is prepared of 5 lbs. of alum, 9 lbs of salt, 24 lbs. of flour, 10 dozen eggyolks or a corresponding quantity of sulphonated oil and 8 gallons of water. The

alum and salt are dissolved in part of the water, then the flour is stirred in. The eggyolk or the oil mixed with warm water is next added and the whole mixture is thoroughly stirred. The skins are drummed with the mixture one hour, then dried, colored and finished.

Sumac Tannage.—Sumac makes soft, light-colored leather that can be easily colored and finished in any desired manner. The tannage is done in paddles; the skins are then dried and finished. The first liquor is rather weak and mellow; and and as the tannage proceeds the liquors are stronger and are warmed. A mixture of oak bark and sumac is also sometimes used; and a shorter tannage is obtained by drumming the skins with the tanning liquor after the grain has been set in a paddle.

Tanning with Alum, Sumac and Oak Bark.—A soft, light-colored skin that can be used in the natural color of the tannage, or colored any desired shade is made by tanning with alum, Glauber's salt, common salt, sumac, oak bark, nutgalls and acid.

The pickle should be removed from the skins by drenching them with whiting and salt, followed by washings in two baths of warm salt water. To make the tanning liquor, dissolve in 5 gallons of water, 6 lbs. of alum, 3 lbs. of Glauber's salt and 4 lbs. of common salt. In another tub boil in 5 gallons of water 5 lbs. of ground sumac, 3 lbs. of oak bark and 1 lb. of ground nutgalls. Mix the two solutions, then strain while the mixture is hot and add to it 4 ozs. of sulphuric acid.

The liquor is used lukewarm and the skins are drummed with it until they are tanned, then allowed to drain twenty-four hours. They are next struck out on both sides and oiled with neatsfoot oil, then dried. A solution of sulphonated oil can be used instead of neatsfoot oil; the skins can be drummed in it or it may be applied by hand. Drying and staking finish the leather. The skins tan cheaply and quickly and when worked out, can be colored any shade or left in the natural color of the tan. The leather is durable and quite moisture-proof.

Tanning with Chestnut Extract.—Sheepskins, prepared as for any other tannage, may be tanned by being hung in chestnut liquor or drummed in liquor made direct from the extract, or from a mixture of chestnut and quebracho extracts. If the skins are intended to be colored after they are tanned, it is best to tan them direct in the extract liquor and then to retan them with sumac. Stock to be run in the natural color is usually struck in the combination liquor giving the shade desired. With very thin skins the main requirement of the tanning material is that it is clean, bright and quick in action. Tanning can be begun in a paddle and finished in a drum, the leather being then dried, treated with sumac, colored, fat-liquored with acid fat-liquor, and dried, and finished.

Tanning with Sumac, Alum and Salt.—Sheepskins may be tanned in sumac liquor and then placed in a solution of alum and salt for one day. Taken out of the latter solution, the leather is rinsed off, struck out and oiled with sulphonated oil, hung up and dried. Coloring can then be done with artificial dyestuffs, basic or acid; the skins are again dried, worked out soft, and finished.

Methods of Dyeing Vegetable-Tanned Skins.

Blacking Vegetable-tanned Skins.—There are many methods and processes of dyeing gambier, quebracho, sumac or combination-tanned leather black. One of the newer and better processes is the use of logwood and titanium-potassium oxalate. Take the dry skins and soften them with warm water. Then drum them first in a solution of 4 ozs. of the titanium salt for 100 lbs. of dry leather; next pour slightly alkaline logwood or hematin liquor into the drum and after the leather has been drummed with the same fifteen minutes, pour into the drum 4 ozs. more of the titanium salt; drum ten minutes longer, then wash and fat-liquor the skins if they were not fat-liquored before they were dried. No copperas, iron liquor or other striker is required. The titanium-potassium oxalate after logwood strikes a soft, deep and permanent black.

When soft black leather is wanted the following procedure

may be adopted: Take the skins out of the tan liquor, wash and press them. Then fat-liquor them with acid fat-liquor, or with an emulsion of soap and oil, and dry them out in the usual manner. When dry, soften the skins with warm water and dye them in the manner that has been described; then wash them and dry them for finishing. A few ounces of fustic paste or crystals boiled with the logwood makes the black deeper and richer. For some purposes the skins work out sufficiently soft without being fat-liquored, but if soft leather is wanted they should be fat-liquored immediately after they have been tanned, or after they have been colored.

There are several direct blacks obtainable that dye the leather a deep black without the use of logwood. Where the flesh-side is wanted colored, the skins are drummed with the solution of dyestuffs; where it is to be left uncolored the black is applied by hand to the grain side only. If the flesh-side is to remain undyed the staining process is applied as follows: The solution of direct black is heated to 125° F. and applied directly to the grain. Usually two coats are sufficient.

If the flesh-side is to be colored blue, purple or blue-black, the skins are drummed with the solution of black and then stained on the grain with the dye, washed and dried. For leather that is to be given a glazed or other bright finish, a black with a greenish cast is to be given the preference.

Dyeing with Acid and Basic Dyestuffs.—Fancy-colored skins must have clear, uniform colors to give satisfaction, but it is not an easy matter to get such colors unless the grain is sound and free from excess of tannin. The tanning should be done in clean liquors and all excess of tannin should be gotten rid of before the process of coloring is undertaken. The dye, especially acid dye, strikes defective spots in the grain very quickly and, because of the precipitation of the dye on such spots and the darker coloring which results from the same, the finished leather shows an unevenly colored grain which detracts from its value. Tartar emetic is useful in removing surplus tannin from the grain and in fixing the dye upon the leather and getting uniform shades. Basic dyestuffs are de-

posited on the skins very rapidly, which often causes uneven coloring. Acid dyes color more slowly than basic dyes and more time is therefore required for the production of well developed shades, but the colors are generally more uniform and more permanent, and the defective spots do not show as plainly as when basic dyes are used.

The skins are usually dried after they are tanned and are softened and washed and cleared before they are colored. The skins are shaved to make them of uniform thickness. When the washing is properly done the colors are clear, full and deep. The dry skins are moistened in a tub and left in piles for some hours to become soft and wet, or they may be moistened in a drum. The water used for this work should be soft and warm since such water has greater softening and and cleansing power than cold water. A safe temperature is from 85° to 95° F. The skins are washed in a drum until they are soft and clean.

Sorting for black and colors is best done before the skins are washed. The light shades require leather that is free from defects, while the dark shades allow of a certain amount of covering from the dye bath.

Clearing Bath.—A clearing of the grain is of assistance in getting satisfactory shades, especially if the leather is of a dark color from the tannage. One pint of sulphuric acid is used for ten dozen skins, in water heated to 85° F. If a paddle is used the skins are run in the acidulated water one hour; in a drum one-half hour. The next operation is treatment with sumac. Two or three pounds of sumac mashed with hot water and mixed in the paddle makes the bath, or a drum may be used. Two or three pounds of sumac are required for eight or ten dozen skins. Run in this liquor one hour, then set the goods out preparatory to the actual coloring.

Coloring with Aniline Dyestuffs.—The sumac bath freshens up the skins so that they take the dye liquor readily. Another formula for the same is: 4 ozs. extract of sumac for one dozen skins. In this liquor the goods are drummed twenty minutes. Then to clear the grain and to set the dye, 2 ozs. of tartar

emetic for each dozen skins dissolved in hot water are poured into the drum, and the skins are run fifteen minutes longer. After this it is best to rinse the skins in warm water, drain the liquor out of the drum, and put the skins back and color them. From 2 to 4 ozs. of dyestuff are required by each dozen skins; the temperature of the dye bath being about 100° F. Fustic may be used in place of sumac. Upon the skins prepared in the manner described either basic or acid dyes may be used. Dyeing is usually commenced by entering the skins in a weak dye bath, which is gradually brought to its full strength. A fairly even temperature of about 120° F. should be maintained, and on this account it is advisable to heat the skins in hot water before passing them into the dye bath. Some dyers color with acid colors and then top off with basic colors. When this is done it is best to apply the basic dye in a fresh bath in order that there may be no precipitation of the dyestuff in the liquor.

Another method of preparing the skins for dyeing is as follows: The dry leather is moistened and softened, then run in a solution of 8 ozs. of titanium-potassium oxalate for every 100 lbs. of dry skins. Drumming with this solution ten minutes gives a yellow base on which any shade of tan, brown, oxblood, etc., can be easily obtained. The skins are drummed with sumac before they are given this treatment.

If acid dyes are to be used the skins can be colored at the end of ten minutes without being washed; if basic dyes are to be applied after the drumming in the titanium solution, the liquor should be run off, the skins washed and then run in the dye liquor. No tartar emetic or bichromate of potash is used in this process of coloring which is neither expensive nor complicated. The colors produced by it are fast to light, full in shade and have less tendency to "grinning" than those obtained by the process of dyeing formerly in use.

Where extract of fustic is used as a mordant, 1½ pints may be used for 100 lbs. of leather; it is dissolved in a pailful of boiling water. The skins together with the quantity of water that is required are put into the drum and the latter is set in

motion. The solution of fustic is next slowly poured into the drum and the drumming is continued twenty minutes. A solution of 4 ozs. of titanium-potassium oxalate is then added to the liquor in the drum and the leather is run fifteen minutes longer. The skins can then be either fat-liquored and dyed, or dyed first, then fat-liquored.

After the leather has been running in the solution of acid dyestuff twenty minutes, 4 ozs. of formic acid for each 100 lbs. of leather are poured into the dyebath to exhaust it upon the leather; the drum is run ten minutes longer and the skins are then rinsed and either fat-liquored or dried.

A fat-liquor suitable for vegetable-tanned skins is, 2 to 4 per cent. sulphonated oil or Turkey red oil or a mixture of sulphonated oil and neatsfoot oil.

Oxblood Shade.—1. For 100 lbs. of dry leather previously treated with sumac use 8 ozs. of titanium-potassium oxalate. Soften the skins with warm water and drum them in the solution of titanium salt at 95° F. for ten minutes. Run the liquor out of the drum and rinse the skins; then dye them. One dozen skins of average size requires about 6 ozs. of amaranth 3-R and ⅛ oz. of malachite green. Boil these dyes in 1 gallon of water; add 7 gallons of cold water and apply to the skins at 100° F. and drum fifteen minutes. Then wash and fat-liquor the leather.

2. Directions for coloring ten dozen skins. Moisten with warm water and run in drum with water at 90° F. Dissolve in hot water 3 lbs. of tartar emetic. Pour the solution into the drum and run the drum fifteen minutes; then drain the liquor off. To color, use 4 lbs. of amaranth 3-R, given to the skins in four portions at intervals of ten minutes. Then add to the contents of the drum 1½ lbs. of amaranth 1-R and 8 ozs. of chocolate brown and run the drum one-half hour. Drain the liquor off; run in the fat-liquor; next add 10 ozs. of bichromate of potash and let the drum run ten minutes longer; then wash the skins and dry them for finishing.

3. The correct shade of oxblood can be obtained on vegetable-tanned skins in the following manner: Boil 10 lbs. of

hypernic chips and strain the liquor. Put the skins into the drum with water at 90° F. Add the hypernic solution while the drum is running, and drum the skins one-half hour. Dissolve by boiling 7 ozs. of amaranth 3-R in 1 gallon of water. Strain the solution through cheesecloth and cool it down to 110° F. by adding cold water. Apply this to the leather in three portions at intervals of five minutes, running the drum fifteen minutes after the last of the dye is poured in. Run out the spent dye liquor and rinse the skins in clean, warm water, and then drum them with a solution of 3 ozs. of bichromate of potash for fifteen minutes; and then fat-liquor them.

Brown Shades.—1. Mordant the skins with sumac and titanium-potassium oxalate. Then dye with 1 oz. of leather brown F for each large skin and less for smaller ones. Drum the leather one-half hour, wash and fat-liquor it.

2. Another excellent shade of brown can be obtained in the following manner: Drum the skins in a solution of titanium salt for ten minutes. Drain the drum and add the color solution made of 4 ozs. of phosphine for leather, ¼ oz. green and ½ oz. methyl violet 2 B. Run the leather in the dye fifteen minutes, then wash and finish it.

Tans and Browns, all shades, are produced by the following method: Sumacked and dried after tanning, use for 100 lbs. of dry leather, washed and cleaned, 1 to 3 lbs. of phosphine for leather and 1 to 8 ozs. of shading brown, according to the depth of shade required. Drum the leather in the color bath a half hour or until it is exhausted. Add while the drum is in motion, 4 to 10 ozs. of titanium-potassium oxalate dissolved in hot water. Drum ten minutes more and rinse well; if not previously fat-liquored apply such liquor and dry the skins for finishing.

It is always safe to prepare the skins by drumming them in sumac liquor for half an hour, then striking them out by hand or machine. The next step is treatment with a solution of titanium salt; finally coloring, washing and finishing.

Tartar emetic can also be used upon the skins after they have been run in the sumac liquor; the goods being then

washed and colored. Leather that is dark, greasy and dirty can be much improved by the use of borax and sulphuric acid. Put the skins into the drum with warm water containing considerable borax and wash them twenty minutes. Run off the borax bath and put into the drum warm water acidified with sulphuric acid and wash the skins ten minutes, then rinse them in clean water. Make a sumac bath strong and hot and add a little salt to it. Drum the leather in this bath thirty minutes, then rinse it in warm water and strike it out for coloring. Run it in warm titanium solution, then in the dye, rinse and finish.

Fat-liquoring.—Whether or not sheepskins should be fat-liquored and the quantity of fat-liquor to use, depends upon the kind of leather that is being made and upon the degree of softness that is desired. If firm leather is wanted the skins can be finished without fat-liquor; if soft leather is desired the skins must be fat-liquored, but not heavily. The surplus water should be pressed out of the skins and the drum heated with steam. Run the leather in the closed drum a few minutes to warm it. Next pour the fat-liquor through the hollow axle, about 2 gallons a time at intervals of five minutes, and drum the leather with it thirty minutes. Let the skins then drain a few hours; strike them out and hang them up to dry.

Dyeing with Fancy Effects.—By a special preparation or manipulation of the leather or by a suitable application of the dyestuff, a great variety of effects may be produced, of which those described in the following notes meet the present demands of fashion.

Marbled effects are obtained by folding the moist leather prepared for the dyeing into a great number of irregular pleats, either by hand, or with the help of clamps on the flesh-side, and pressing the pleats so formed as firmly and as closely together as possible, whereupon the leather is dyed either by spraying the dye on, or by placing it on a metal plate and dipping it quickly into the liquor. This process must be carried out very rapidly. The leather is then rinsed in pure

water kept ready at hand. The greatest variety of effects may be obtained by repeating the operation several times with different color solutions, and the effect may still further be varied by treating in a like manner leather previously dyed a uniform shade. The method of dressing which follows is the same as usual. Spray-dyeing is carried out by spraying various dyestuff solutions by means of a blow-pipe provided with a fine nozzle onto the leather spread out flat on a table or hung up. There is of course plenty of scope for a great variety of effects according to the dyestuff solutions applied, the leather, if desired, being previously dyed to some uniform shade, or stencil plates being used, which again varies the effects obtained by this process. In order to insure good fastness to rubbing and water, solutions of color soluble in alcohol, with the addition of some shellac, are frequently used for spraying on. Changeant dyeings are produced by spraying the color solution sideways onto the leather previously pressed at will; the side opposite to the pressed parts thus remains either undyed or is sprayed over with a different color solution. This method is frequently also applied for producing antique leather, so-called. The rough, irregular, wrinkled effects which are in favor for leather of this description are produced by pleating the skins and crushing them up very tightly in sacks, nets, etc., tanning them in strong tanning solutions, and only opening the bundles to complete the tanning when there is no longer any fear of the wrinkles disappearing again. The antique grain may also be imparted to the leather by a pressing process. In dressing leather of this kind, the wrinkles should be well preserved, and superfluous setting-out must be avoided.

For producing antique effects, various methods are applied, for instance: The raised portions of the grain of the previously dyed and dried leather are buffed by means of fine emery paper or pumicestone.

The raised portions of the surface of the previously dyed and dried leather are given a coating with a fatty resist consisting of wax and vaseline, whereupon the deeper portions

are dyed by means of a soft sponge or a brush or by spray-dyeing. All the portions protected by the wax resist remain undyed. Any excess of dyestuff that may be present is then removed with a moist sponge and the leather is dried. The dyestuff intended to stain the deeper portions of the grain has to be applied in a rather highly concentrated form owing to its rapid absorption, and it is advisable for such purpose to use acid dyestuffs or basic colors which have no tendency to bronze. The wax resist may if necessary be replaced by collodium varnish.

If collodium varnish colored with cerasine and mineral colors be used for dyeing the deeper portions of the grain of the previously dyed and dried leather, the leather is first given a coating of thin Irish-moss decoction. When dry, suitably stained collodium varnish is applied, which after being allowed to dry for a short time, is removed from the raised portions of the grain by means of a linen pad dipped into amyl acetate and pressed out well, the bottom shade then reappearing. Antique effects may likewise be obtained in the reverse manner by dyeing the raised portions of the grain with colored gelatine, shellac dissolved in spirits, or collodium varnish, the deeper parts of the grain thus retaining the original shade. By clever manipulation exceedingly handsome and entirely original effects may be produced. When using collodium varnish, it is an advantage to add some castor oil, in which the dyestuff may be dissolved, in order to enhance the pliability of the leather.

Gelatine and shellac dissolved in spirits may be colored with basic colors or with dyestuffs soluble in spirits, and collodium varnish with cerasine colors and the addition of mineral colors to any desired shade.

In order to remove from the leather the smell peculiar to collodium varnish with which it has been treated, it is hung up for some time in a well-ventilated room at a temperature of 110° F. The subsequent dressing is the same as customary for colored leather.

Bronze Dyeings (*Dyeings with Metallic Lustre*).—The leather

is dyed in the first place in the ordinary manner in the tray with a solution containing 1 to 1½ ozs. of some suitable basic color per 1½ gallons of water (dissolved with the addition of alcohol), then rinsed, and topped with a solution containing up to 2 ozs. of a suitable acid color per 1½ gallons. It is an advantage to treat such leather before dyeing with a solution of tartar emetic. After thus dyeing in the tray, the leather is struck out from the flesh-side, the grain then oiled lightly with linseed oil, and dried. The subsequent glazing may be facilitated by lightly rubbing the grain side immediately before the glazing with a cloth containing a little linseed oil.

The following is another method of producing bronze dyeings of particularly good resistance to water: The leather is first dyed as desired with a strong solution of some basic color. After dyeing, it is first glazed by machine, and then coated with collodium varnish diluted with about half its weight of amyl acetate and stained with a suitable basic dyestuff, and dried. This treatment is repeated if necessary, and yields an intense bronze lustre, which may be still further enhanced by severe glazing. For so-called velvet or antelope shades which are produced on buffed, bark-tanned and sumac-tanned cowhides and calfskins, or are imitated by dyeing the flesh side of the bark-tanned sheepskins, a very deep penetration is as a rule required. This is ensured to best advantage by working according to the following method: The leather is first prepared like other colored leather, buffed in a dry state, and soaked. It is then dyed warm in the drum with acid colors, some ammonia being added at the beginning of the dyeing operation. According to the thickness of the leather, up to 5 per cent of dyestuff, calculated on the weight of the moist leather, is used. The material is dyed for about one hour, the requisite quantity of sulphuric or formic acid, up to ½ per cent., being added towards the end of the dyeing operation. The leather is then rinsed thoroughly, set out, oiled and dried. The subsequent currying is done in the usual manner. Leather of this kind is treated frequently the same as semi-chrome leather. Some shades, especially black, may to good

advantage be produced by topping the acid colors with basic colors; black is, for instance, produced by dyeing with 2 per cent. Nerazine G, shaded if necessary with other dyestuffs, the requisite quantity of acid being added after about an hour's dyeing, and the leather topped with 1 per cent. Leather Black T B or Velvet Black B and the addition of some alum or acetic acid. The leather is then dyed for about another twenty minutes, rinsed, set out, oiled, and dried in the customary manner.

When dyeing these leathers by the staining process, the solutions of acid colors are brushed on without the addition of acid; the leather is then dried and the second deep coloring given, this time with the addition of formic acid in order to to fix the acid color. A dense shade of black is produced with about 1 lb. of Nerazine G, shaded if necessary with orange etc., and the addition of 8 ozs. of formic acid per 10 gallons of dye liquor, the leather being then dried. This treatment is followed by the application of another solution of 1 lb. Leather Black T B per 10 gallons of staining liquor. A preparatory treatment with titanium-potassium oxalate, and an after-treatment if necessary with a tanning solution, enhances the fastness to rubbing of these kinds of leather.

Seasonings for Colored Skins.—1. A glazed finish is obtained on russet and colored leather by using this dressing: Dissolve 4 ozs. of blood albumen in 1 gallon of water over night. Cook 4 ozs. of granulated gelatine in 1 gallon of water and let it cool. Mix ½ pint of white varnish shellac with ½ pint of ammonia. Mix the three solutions thoroughly and add enough water to make three gallons. Apply to the skins with a sponge and glaze when dry. For colored skins use a little less ammonia and make the finish a week before it is to be used so that the ammonia will evaporate. For a plain natural finish give the leather two coats of finish and roll it while it is wet, then hang it up to dry and when dry give it another coat of the dressing.

2. Dissolve ½ oz. of bichromate of potash in a little hot water, and when the solution is cold add to it, 2 gallons of egg-albumen solution; then add 1 quart of acetic acid and 10

gallons of water. Strain and apply to the skins, and while the grain is damp iron or roll, and a good dull finish will be obtained.

3. Boil flaxseed often and for a long time with a little water. Strain the solution before using it and beat it up the same as the white of an egg. To a pailful of water add 1½ pints of milk, the whites of two eggs well beaten and ½ pint flaxseed also well beaten up. This finish should be put on evenly and without streaks by means of a soft sponge or a sheepskin pad. When it has been put on, the skins are hung up to dry and then rolled.

If embossed leather is wanted, the skins should be seasoned and then embossed by the use of an embossing machine. Imitation of seal, monkey, alligator and other skins are made in this way. When the leather has been properly tanned and colored beautiful effects are produced.

Finish for Embossed Sheepskins.—Sheepskins tanned by a vegetable process that are to be grained or embossed can be seasoned with this finish : 2 ozs. of caseine ; 2 ozs. of O shellac ; ½ oz. ammonia ; 1 gallon of water. Boil all until dissolved, stirring continually. Let stand over night or until cold. Add 1 gallon of water and ½ oz. of glycerine, mixing all together. Apply with a sponge, then dry. The skins are then ready for glassing on the machine. After glassing, they may be grained by arm board and embossed, which is the final operation.

Finish for Black Embossed Sheepskins.—A lasting finish is obtained by using this dressing on skins that are to be printed, grained, pebbled or embossed. Put into 2 gallons of water 8 ozs. of extract of logwood, 1 oz. of bichromate of potash and 2 ozs. of prussiate of potash, and boil until dissolved ; cool and strain. To each gallon of the solution add 2 quarts of beef blood or of blood albumen ; either will do. Give the skins an even coat of this dressing and let it dry. When the leather is ready to be printed or embossed, dampen the grain evenly so that it will take the impression without the grain being cut. Then print, grain, emboss or pebble according to the grain

that is wanted. Skins can be embossed in a dry state on the modern embossing machine, although a certain amount of heat is used to make the impression easier and more permanent.

On some sorts of embossed leather it is desirable to have the crevices of the grain a lighter shade than the upper surface, which gives the leather a shaded appearance. To obtain this effect the skins should be embossed before they are colored and then colored by hand or table coloring, which not only produces the desired appearance as regards color but also leaves the flesh clean and uncolored. East India skins color this way very nicely. When skins are colored first and then dried and embossed, the plate of the machine should be large enough to cover an entire skin so that there will be no plate marks on either the flesh or grain side. To keep the flesh smooth and free from plate marks, a thick piece of cowhide split should be spread over the bottom bed of the machine. The skins that are to be embossed are placed grain side up on this split. The plate then comes down onto the grain and embosses it while the flesh side remains smooth. Before embossing is done the grain must be seasoned and glazed with considerable pressure so that it will be flattened out and smooth. Generally two or three glazings are necessary to get the right finish. When a sort of crushed or wrinkled grain is desired strong tan liquor is used, which contracts the grain. Embossing is generally more satisfactory since it produces a more uniform result.

Very thin fancy leather is obtained by boarding or embossing plump skins and then splitting them. The grain should be diced by rolling with a diced roller and then hand-boarded. The flesh splits are finished into ooze leather.

The Coloring and Finishing of India-tanned Skins.—India-tanned sheepskins and goatskins in various colors and finishes are used for the manufacture of shopping-bags, traveling-bags, belts, collar boxes, bookbindings, carriage trimmings, linings, etc., and in the making of leather novelties and specialties. These skins have considerable firmness and durability and

yet are soft and pliable, and when colored and finished are not excelled by any other leather. They can be finished with any kind of grain, in any color, glazed or dull, smooth, grained or embossed; they can be made soft or firm as may be desired. Large, heavy skins are used for suitcases and bags; the smaller ones for purposes where light, soft leather is suitable. Bookbinders use India skins in a variety of colors, the staples being dark green, dark blue, wines and blacks with pebbled grain. These skins are colored and finished, and are then split to the thickness desired, as bookbinders' leather must be fairly thin to cover the backs and corners of books.

The skins require to be thoroughly washed and cleansed so as to remove from them all surplus tannin and dirt and dust. They are, at the beginning of the dressing, shaved and then freed from dirt and loose tanning matter by means of a short drumming, or by simply brushing a weak soda or soap solution over the grain. Before washing is begun it is best to soak the skins in warm water, then to let them lie in piles a few hours to soften. As soon as they are pliable they are washed in a suitable drum.

Washing.—The water used should be at a temperature of 90° F., and its efficacy is enhanced by adding to it some borax or washing soda, in quantity from 2 to 3 lbs. for 100 gallons of water. The skins are washed in this solution for 15 or 20 minutes, then in clear water and made ready for further treatment. It is necessary to retan the skins with some tannage that makes soft and light-colored leather; and for light shades it is necessary to bleach the skins with sulphuric acid after the borax bath. The borax cleanses the skins perfectly; it also darkens the color. The acid bath serves to brighten up the color. Very thorough washing is afterwards necessary to remove the acid. To a barrel of water enough acid should be added to bring the solution to the degree of strength that will bite the tongue when tasted. From 2 to 3 ozs. per gallon of water may be used. Drum the skins in the acid solution, then wash them thoroughly to remove every trace of acid. They are now ready for the sumac treatment.

Retanning with Sumac.—The sumac liquor should be quite strong and at a temperature of 105° F., and the leather can be treated in a drum or in a paddle. One to two pounds of sumac may be used for each dozen skins. The leather is run in this sumac liquor from thirty minutes to an hour; after this it is washed in warm water, struck out with a slicker and hung up to dry. When it is dry it can be dyed any shade of color. Coloring can also be done immediately after washing from the sumac.

Instead of sumac, quermos extract may be used. It produces a light color and is stainless. After the washing from the retan the skins have a nice color and they can be finished without dyeing and used for some purposes. The borax removes some of the tanning material and much of the natural grease. The acid bath brightens up the leather and the sumac replaces the tan washed out, thus making the skins softer and preparing the grain for the subsequent dyeing. Some tanners use hyposulphite of soda in the wash bath in place of borax, 10 lbs. of it being dissolved in a barrelful of hot water; the solution is used at 110° F. and washing for a few minutes afterwards is all the skins require.

Coloring the Skins.—To prepare the dry leather for coloring it is moistened with warm water in a drum or tub. For single pairs of skins the tray is used, for a dozen or a couple of dozen pairs a rectangular box, and for larger quantities the drum.

The dyeing process is usually begun by entering the skins into a weak dye bath, which is gradually brought to its full strength. For single pairs, eight or ten minutes is sufficient; for larger numbers from fifteen to thirty minutes should be allowed. A fairly even temperature of about 115° to 120° F. should be maintained and on this account the skins are sometimes heated before they are passed into the warm liquor. The weights of dyestuffs are calculated on the number of skins, the average size being thereby taken into consideration. Light shades require 1 to 1½ ozs., medium shades 1¾ to 2¼ ozs., and full shades up to 5 ozs. per dozen skins in the box, paddle or drum, or ¾ oz. per pair in the tray.

1. One method of coloring the skins is as follows: They are run in a drum with warm water until they are soft and opened out. From 2 to 5 ozs. of tartar emetic in solution for each dozen skins are then poured into the drum and the drum is run fifteen minutes. This clears the grain and sets the dye. The water is then drained out of the drum and the skins are colored with basic dyestuffs.

2. Another excellent process is to drum the skins in a warm solution of 6 to 8 ozs. of titanium-potassium oxalate for 100 lbs. of dry leather for ten or fifteen minutes, then to rinse them and to apply the dye. This process is recommended since it mordants with a titanium tannate, itself a yellowish shade, on which all shades of tan, brown, green, blue and maroon can be easily obtained. After running off the liquor a slight rinsing with warm water is advisable but not always necessary. If acid dye is to be applied the rinsing may be omitted; if basic dye is to be used it is necessary to wash the skins only when the mordant bath has not been fully exhausted. After the desired shade is obtained the leather is washed and finished. The first bath with acid colors is frequently followed by a second bath with basic colors; in order to prevent a precipitation of the latter it is best to top in a fresh bath.

The dyed skins that are to be subsequently glazed should on leaving the liquor correspond approximately in shade with the dry pattern; if they are to remain dull or are to be glazed but lightly, a wet portion of the pattern should be used for matching.

After dyeing, the leather is rinsed, set out, and dried tacked on boards. If soft leather is wanted the skins may be fat-liquored. Finishing is done according to the demands made. It is often useful to apply a coating of basic colors by brushing or to stain the dressing slightly in order to correct the shade or to give it a fulled and more covered appearance.

With acid colors it is advisable to use formic acid, 2 parts by weight to 4 parts of acid dye, to prevent the dyestuff from precipitating and to exhaust the bath. The acid should be

diluted with one hundred times its weight of water and should not be added to the dyebath until the leather is well colored. Formic acid entirely evaporates during the dyeing of the leather; hence it has no harmful effect.

Dyeing the Skins Black.—1. India-tanned skins can be blacked through flesh and grain by the use of logwood and titanium-potassium oxalate. A fairly strong logwood liquor, slightly alkaline, should be used, and 10 ozs. of titanium-salt for 100 lbs. of dry leather. Dissolve the titanium-salt and drum the leather in the solution ten minutes. Next drum with the logwood liquor fifteen minutes. Then, to complete the process, pour the rest of the titanium-salt in solution into the drum and continue drumming ten minutes; finally wash the leather. No copperas or iron liquor is used as the logwood and titanium-potassium oxalate dye a deep, permanent black. It is advantageous to use logwood crystals and to add a little fustic paste to the liquor to intensify the black.

2. To dye flesh and grain of the retanned leather the skins should be first drummed in a solution of methyl violet and then in an aniline black solution. For 250 lbs. of dry leather 8 ozs. of methyl violet aniline and 5 or 6 ozs. of aniline black are required. Drum in the violet solution twenty minutes; next for fifteen minutes in the aniline black liquor to which 4 ozs. of titanium-salt in solution have been added, then wash and finish. The seasoning that is used should contain 1 lb. of titanium-salt to the barrel of seasoning. To get the best black the black aniline should have a green cast. Skins that are to be fat-liquored should be so treated after drumming in the violet aniline, then dyed black.

3. Whether the flesh side of the skins is to be left uncolored or to be dyed black or dark blue the use of the special direct leather black T B (Cassella) can be recommended.

If the flesh side of the skins is to be left undyed the black is applied to the grain side by the staining or brushing process. The dye solution consists of 1 lb. of dyestuff and 8 ozs. of acetic acid in 10 gallons of water. The dye liquor should during its application be kept at 130° F. and be thoroughly brushed

into the grain. Ordinarily two applications are sufficient for dry leather.

4. If the flesh side of the leather is also to be dyed black, the dye, leather black T B, is applied in a paddle or drum, preferably the latter. Usually 1½ lbs. of the dyestuff per 100 lbs. of leather are required, and 3 to 5 ozs. of acetic acid are added to the necessary volume of water.

5. Where the flesh side of the skins is to be dyed dark blue and the grain black the leather is first dyed with the direct black in a drum for a half-hour at 115° F. It is then strongly set out and, after having been dried, is dyed on the grain by the staining or brushing method.

6. The skins can also be flesh-colored by the use of blue nigrosine. For each dozen skins 2 to 3 ozs. of the nigrosine are dissolved in hot water and applied at 110° F. The skins are drummed in the solution twenty minutes and then blacked upon the grain by hand or on a machine with logwood and iron liquor.

7. The leather can also be dyed by being first drummed in logwood liquor and then the color developed in the drum by the addition of iron liquor or by passing the leather through the grain-blacking machine.

Drumming the leather in a warm solution of sulphonated oil or adding the oil to the logwood liquor increases its softness and improves its texture.

Notes on Coloring.—India-tanned sheepskins and goatskins contain considerable grease as well as vegetable tanning material. The grease must be removed from the surface of the leather before it can be dyed a clear, even color. This is done by washing the skins first with soda to free from grease; then retanning with sumac; then clearing with sulphuric acid; finally rinsing with plenty of water. The skins are then colored with basic or acid dyes.

The skins to be dyed black on the grain with white backs are stained by brushing with 8 ozs. of leather black T B, 2 ozs. of acetic acid and 2 quarts gum-tragacanth solution to one pailful of water.

Pickled sheepskins tanned in sumac are simply cleared with sulphuric acid and rinsed in water. Skins tanned in quebracho for fancy colors are washed up in sumac, which is then fixed with tartar emetic. India sheep and pickled sheepskins are colored similarly with acid and basic dyes, and can be considered together. Whenever good fastness to washing is required, the skins should be colored with basic dyes and and the color set with bichromate of potash. On very light shades, which must be slightly saddened, bichromate of potash should be used when possible instead of blue or green dye. When full shades are made with acid dyes, such as bright reds, dyed with scarlet E C or brilliant crocein M O O, about 2 quarts of formic acid to thirty dozen skins should be added to the bath towards the end of the dyeing operation. Formic acid is preferable for this purpose as it evaporates and does no injury to the leather.

Dyes for ooze leather should be selected for their penetrating power. Excellent results in coloring sheepskins can be obtained by dyeing first with acid colors, as, for example dyeing coffee shades, first with Indian yellow G; tan shades first with orange extra; and red brown shades first with fast brown B N, and then topping with the proper mixture of diamine phosphine 2995 J, Bismarck brown E E, Methylene blue B B or new blue R.

The acid dyes produce an excellent level bottom for the basic colors. Light pearl, grey, champagne, blue and heliotrope are most successfully obtained by easily leveling dyes, such as Cyanole fast green, Cyanole F F, Lanafuchsine S G and S B, Orange extra, acid yellow A T. These dyes give also good fastness to light.

The further dressing has to be done according to the requirements. It is often useful to apply a coating of basic color by brushing or to stain the finishing dressing slightly in order to correct the shade or to give it a fuller and more covered appearance. When dyeing leather that has a very defective grain, from 1 to 2 lbs. of potato starch may be added to 10 gallons of dye liquor in order to insure a thorough covering

of the grain, in brush dyeing. Where the grain is hard and of inferior absorbing property its affinity for the dyestuff may be improved by brushing on a strongly diluted solution of lactic acid before the dyeing.

Finishing the Leather.—India-tanned skins are finished in various ways. Large quantities are finished in smooth glaze and dull. Some are grained with a roller or embossed and then boarded up by hand. Others are glazed and grained. For some purposes, such as bags, belts, etc., they are hand-grained three ways, which gives a round and half-round grain. To get a diced grain the skins are rolled with a straight grain roller and then grained crosswise; after this they are boarded up, which softens them and produces a uniform grain similar to the box grain. Some skins are pebbled and then boarded. The finish that is put on depends upon what purpose the leather is to be used for.

Black Glazed Finish.—The skins, after they have been staked, are in condition to be finished. Seasoning for glazed finish is applied and rubbed into the grain. The skin is then dried in a warm room and glazed. A second coat of seasoning is then applied, dried and glazed. Sometimes it is advisable to stake the skin after the first staking and before the second application of seasoning.

Smooth Dull Finish.—A fine dull finish and soft, full skins are obtained in this manner: After staking, they are given a coat of dull dressing, dried and ironed; then they are staked lightly.

Finish for Colored Skins.—An egg-albumen solution produces a fine glazed finish. A good formula is: Egg-albumen solution, 1 gallon; bichromate of potash, ¼ oz.; acetic acid, 1 pint; water, 5 gallons. Mix and keep in a cool place. Apply with a sponge and when it is dry, glaze.

For light shades egg-albumen is used; for dark shades blood-albumen. The albumen is soaked for several hours in cold or lukewarm water with the addition of a little ammonia. A small addition of gelatine dissolved in water enhances the glaze. For preserving, formaline is used, also carbolic acid or

mustard oil, the smell being neutralized with oil of mirbane, lavender oil, etc. If only a moderate glaze is to be produced decoctions of linseed, flea-wort seed, tragacanth, Irish moss, etc., or diluted milk may be used, the dressing being tinted with suitable dyestuff. The dressing is brushed onto the leather, which is then dried and polished on the machine.

Retanning with Chrome Liquor.—Soft, durable leather is made by retanning India-tanned skins with one-bath chrome liquor. The skins are first sorted and all superfluous parts trimmed off; they are then soaked and shaved. After shaving they are washed thoroughly, drained a few hours and then retanned with chrome liquor. Any good one-bath liquor may be used. A stain can be added to the liquor and retanning and staining performed in one operation. When the retanning is completed the leather is washed, pressed or struck out, dyed, dried and finished.

Morocco Finish.—There are three different ways of giving the leather a grain or the morocco finish as it is called. The best way, of course, is by graining it up naturally without giving it any false grain. This is done dy a cork board when the skin is wet. The grain of the skin is turned to the grain and pushed backward and forward in eight ways, turning the skin each time. This method throws up a beautiful grain and makes a regular morocco figure. Heavy skins throw up a large grain, while the grain of light skins is fine and small. To keep this grain in so that it will not pull out the skins are hung in heat and dried. This, of course, makes them hard and stiff, and it is necessary to go through the same work again only with the skin dry instead of wet. This keeps the former grain and makes the leather soft and pliable.

Another good way to do where prices enter into the question is to take the skins from the dry room, wet them and put them under a jig roll. This is a small steel roll about six inches long, cut with indentations, so that the roll under great pressure on wet leather gives a pebbled or morocco figure. This also must be dried in, then wet down and hand-grained just as the natural grain skin. This gives a beautiful regular

morocco grain that will not pull out or flatten; and it is done without deterioration to the leather itself.

The least desirable way, though much used, and really the best known among bookbinders, is embossing. The objectionable feature to this process is that to keep the figure in, it is necessary to use heat. This injures the fibers and the grain, leaving the leather with an unnatural grain. No good work should be embossed. The process is most suitable for sheepskins or other skins when no other method will do, or else for any poor stock which cannot be finished in any other way. The grain can be made bright at any time during these processes by glazing.

The leather is next split. The grains are used for bookbinding and other purposes, the splits are made into ooze stock, which is used for pillows, linings, covering handles of golf sticks, etc.

Crushed Levant Grain is obtained by embossing the skins, then seasoning and glazing them as the grain must be flattened out. Two or three glazings are necessary to get the right finish. The colors are generally blue, red, green, brown, tan and wine. To get the best results in coloring, it is advisable to emboss the skins before coloring, and coloring afterwards by table coloring, which leaves the crevices of the grain a lighter hue than the upper surface, which is desired' besides leaving the flesh clean and white.

Plump leather always takes a better grain in boarding. For boarded grains it is best to roll them with a diced or straight grain roller. Should the latter be used, the skin should rolled diagonally to form a small diamond, which is afterwards hand boarded. The leather, if sufficiently plump, can finally be split so that the grain will come out the desired weight. The grains finished as described are used for collar and cuff boxes, belts, hand bags, pocket books, music rolls etc.

Ooze or Suede Leather.—India-tanned skins that have defective grain can be made into ooze or flesh-finished leather more profitably than into leather finished on the grain. Softness

and good color are the essential qualities. A short, smooth nap is also important; this is obtained by the skins being ground on stones for this purpose, and they are then colored.

The following descriptions gives the outline of the methods used in finishing India-tanned ooze leather: The skins are sorted and those that have good grains are colored and finished upon the grain, while those that have poor grains are thrown aside for ooze finish. These imperfect skins are then thoroughly washed and cleansed of dirt and surplus tanning material; they are struck out to rid them of surplus water and are then ground while in the wet condition.

The next process is retanning with sumac, which not only retans the skins but also prepares them for coloring. The sumac is applied in a warm solution in a drum, and the skins are then colored. Coloring is usually done in a drum, the tumbling and pounding being necessary to pound the color into the leather. After the skins are colored they are fat-liquored, dried, staked and ironed. Ironing must be carefully done or it will cause the nap to be shiny and if the iron is too hot, it will burn the leather. The skins can also be run on an emery wheel when staked and dry, which makes them soft and smooth. Grinding on stones while wet and before retanning is the best way to treat the skins as it produces the close fine nap that is so desirable.

When the skins have been dried after the treatment with sumac they are softened by drumming in warm water to which has been added a little neutral soap. The dyestuff is dissolved and added through the hollow axle of the drum and the skins are drummed a half hour. Some formic acid (about half the weight of the dyestuff) is then added and the drumming is continued another ten minutes in order to exhaust the bath. The leather is then set out and dried. When dry it is moistened in sawdust, velveted again by drumming in the dry drum, glazed or ironed on the grain side and finished by brushing.

Skivers.

A skiver is the grain side of a split tanned sheepskin. The skins are split after they have been limed; the grains are then drenched and tanned the same as whole skins, with sumac, bark, alum or some other tannage. Skivers are used in the manufacture of leather goods, for linings, hat sweat bands, etc. They can be tanned with any material that is used in the tanning of sheepskins. Sumac is in common use; quebracho extract and quermos and hemlock extracts also make good skiver stock. If soft white skins are wanted, alum is used. Very little tanning is required. It is generally sufficient to get the stock well struck through with the tanning material.

A good tannage is a mixture of two-thirds quebracho and one-third hemlock extracts. This produces a light and uniform color.

Coloring and finishing are the same as upon skins; but skivers, being very thin, require careful handling to prevent them from getting torn.

Flat Finishing of Skivers.—The class of work under this heading covers a large assortment of different grains, rolled and embossed, also plain glazed. After the skins have been lightly fluffed, if required, they should be given a coat of Irish moss solution on the flesh, this having the effect of making them feel firm and stout. The following is a practical way of making up the moss mucilage.

Equal parts of Irish moss and water are allowed to boil slowly for about two hours, after which the solution is carefully strained. When it is cold it is ready for use.

A coat of moss is next applied to the flesh side, and the skivers are slowly dried out. The flaming, or filling of the grain follows, the solution for this purpose being made as follows: 10 ozs. liquid blood albumen, 1 oz. of milk and 1 quart of water. Apply liberally with a brush as this class of skivers requires considerable nourishing. A suitable seasoning is then applied with a pad.

At this stage the skivers are laid under damp blankets for

not less than twelve hours, when they are ready for the machine work. If the goods are for long grains, they should be first well rolled with a dull roller, either a four or a five, from belly to belly, two or three times if necessary, taking care to bring up a good color. Now break the skin down on the flesh side with a hand board covered with rubber, air off and then glaze carefully. This has the effect of giving them a nice level face and also flattens the roller work down a bit.

The skivers are now embossed on the plate machine with whatever grain is required. If, however, the goods are for straight grains, they should first be rolled with a number seven size roller, lightly boarded on the flesh, and then cut through with a number four to separate the "oat" which has been made by the number seven roller, and finally lightly finished off on the glazing machine. Goods for cross grains should be rolled on the cross with a number five, boarded on the flesh, well glazed and then boarded again on the grain. For plain glazed skivers great care should be taken in glazing, no matter what class of machine they are to be glazed on. It should be in perfect condition and have a good level stroke. Too much pressure must not be used, otherwise the goods will be very brittle, and it will be impossible to finish many of them without tearing them. Such goods should be well glazed, aired off with a little heat if possible, and then lightly drummed off.

For glace embossed skiver grains only the stoutest skivers should be selected; those which show ribby marks should be cast out. Skins showing rough flesh should be cleaned up by a light fluffing on the wheel, care being taken that the carborundum or emery wheel is not rough enough to leave marks. Now give the skivers a good coat of Irish moss solution of about the same strength as that for flat finishing. Next fill in with a solution composed of 8 ozs. liquid blood albumen, 1 oz. milk, 1 quart water, adding a little color solution if required.

The goods are now dried slowly; if dried too rapidly they will be harsh and liable to crack. When dry, they can be

broken down on the flesh side with the rubber-faced hand board, and placed between damp sacks for about an hour, when they are ready for embossing to the grain required. This last fluffing is necessary if the natural grain is to be imitated as nearly as possible. In the embossing the impression of the print is of course left on the flesh side, or, to be exact, the impression on the grain side is, of course, raised up on the flesh side, and vice versa. By running the fluffing wheel lightly over the flesh side, it only touches the skin where the raised parts are; consequently this part of the skin is left a little thinner, and the glazing tool cannot get to the bottom of these parts, being held of the raised parts of the print. Now the friction caused by glazing darkens the goods or brings out the color, the result being a lighter shade between the scales and what appears a much more natural grain. The skivers are now ready for seasoning and the final work of finishing. There are great possibilities in this class of work; almost every week there is a fresh design placed upon the market, while there is a constant and increasing demand for both glazed and plain embossed skivers. The above article on the finishing of skivers is taken from *The Leather World.*

Sheepskin Fleshers.

When sheepskins are split out of lime the grains are delimed and tanned in bark, sumac or some other tannage and finished into skivers; the splits or flesh portions are made into chamois leather and used for linings, gloves and other purposes; they are also tanned in other ways and used for various purposes where inexpensive material is required. Any one of the alum tannages for whole skins can be used in tanning the splits. Tanned with alum, salt, eggyolk and flour, they make very soft stock that can be used in the white or colored any shade. The chrome process also can be used, the splits being fat-liquored and dried and staked in the usual manner. A formaldehyde tannage also can be applied. For each 100 parts of pelt 1 part of commercial formaldehyde in the necessary quantity of water is used. The skins are left

in the liquor from twelve to twenty-four hours and are then neutralized, washed and fat-liquored with 6 parts of soft soap, thus making a very soft leather resembling chamois skin. Yellow stock is obtained by using moellon instead of soap as a fat-liquor.

A process for sheepskin splits that produces stock that closely resembles castor or mocha leather is carried out as follows, the quantities of materials being sufficient for two dozen fleshers of ordinary size: The goods are immersed, stirred about and pounded for thirty minutes in a solution of 1 lb. of alum, ½ lb. of flour, ½ lb. of oatmeal or 1 lb. of either alone, 1 gill of oil and sufficient water to process nicely. Tanning can be done in a drum in about thirty minutes.

The goods are then immersed for a half hour in a solution composed of 1 gill of ammonia, ½ bar of soap, ½ oz. of soda, ½ lb. of salt and 2 ozs. of whiting or ochre, all boiled in 1½ gallons of water. To this solution is added either 1 lb. of flour or 1 lb. of oatmeal mixed in 6 quarts of water and the fleshers are drummed in the mixture thirty minutes, after which they are dried, worked soft and finished upon either side. The skins dressed in this manner are very soft and pliable, elastic and strong. After having been treated to the first part of the process they may be dried and finished. Yet it is desirable to use the entire process as they are thus given a superior quality and a capacity for a better finish.

Another excellent process is as follows: The splits, drenched and free from lime, are put into a drum together with a solution of 12 ozs. of alum and 4 ozs. of salt in a half pailful of water and drummed thirty minutes. Then add one pailful of flour for each ten dozen skins and one quart of fresh eggyolks and run the drum thirty minutes longer. Take the skins out of the drum and hang them up to dry. Put them away in a dry, cool place for a few weeks; then dampen and mill them in flour, knee-stake them and run them on a fine emery wheel. After this has been done, wash the skins and if they seem to require it give them 1 to 2 quarts of eggyolk to twelve dozen skins; dry them again and stake out soft. The finished

skins should be very soft and white. They can also be colored any desired shade.

One hundred pounds of pickled splits can be tanned with 3 lbs. of sulphate of alumina, 2 lbs. of salt and 5 lbs. of flour. Add to the alumina and salt solution 4 ozs. of bicarbonate of soda and, if very soft goods are wanted, a little eggyolk and olive oil to the solution, then the flour paste, and drum the skins with the mixture two hours. Stake, tack out and dry.

Chamois Leather.

Chamois leather is made at the present time almost exclusively from sheepskins. It is produced by the action of oil upon the raw skins; and is distinguished from all other classes of leather by remarkable softness and open texture. After the wool is removed, the skins are limed long and thoroughly; they are then split on a machine adapted to the work, the grains being tanned and finished into fancy leather and the flesh splits into oil-tanned or chamois leather. The splits are delimed, washed and pressed to rid them of the surplus water and to make them as dry as possible.

The skins are then given a thorough beating in machinery constructed for the purpose, in order to soften them, after which they are sprinkled with cod oil and again beaten to force the oil into the leather. The best grade of Newfoundland cod oil is considered most suitable for the purpose. The process of oiling the skins and beating them is two or three times repeated or until they have assumed a mustard color. They next undergo a process of heating. By this process the oxidation of the oil, which began during the previous process is completed by the fermentation that results in the skins. The heat is generated spontaneously. The skins must be watched very closely and frequently turned over. When the heat rises to too high a temperature the leather is seriously damaged. The heat destroys all the organic matter in the skins. The highest temperature allowable is 140° F. When fermentation ceases and the skins are no longer susceptible to heating they are treated to remove the oil. This is done by

washing them in hot water and then pressing in a hydraulic press. The grease that is squeezed out in this way is degras, an article used by tanners. The oil may also be removed by washing the skins in a solution of soda ash, which causes the grease remaining to saponify. This saponified oil is then neutralized with sulphuric acid and forms the oil known as sod oil. A certain percentage of the oil should be allowed to remain in the skins so as to give them softness.

The finishing process consists of dyeing, staking and smoothing down all unevenness on the surface. The skins may be bleached or colored, as may be desired.

Coloring.—The coloring of chamois leather can be done most successfully in a drum, the tumbling and pounding being helpful in getting thorough penetration. First of all the skins must be freed from the oil that has not combined with the fibres, or from any acid or soda that may be present. The skins are soaked in lukewarm water and then washed well in water containing one per cent. of borax. If the liquor has a milky appearance the leather is rinsed again in lukewarm water. Dyeing can be done by brushing the color solution onto the skins, by kneading or stirring them about in the liquor, or by drumming them with it in a drum. Fastness to washing is usually essential and this quality is secured by the use of Immedial colors (Cassella).

1. These dyestuffs are dissolved in boiling water, with the addition of their own weight or slightly more than their weight of sodium sulphide crystals; then allowed to cool. Formaline, one-tenth of the weight of the dyestuff, and soap, dissolved in water, one-fifth of the weight of the dyestuff are then added to the solution of color. The leather is dyed by being drummed twenty minutes in the cold dye solution. It is then rinsed and washed in a soap solution containing about one per cent. of soap. To make the skins very soft, ⅓ to ½ oz. of eggyolk for every skin is added to the soap solution.

If particularly high demands are made with regard to fastness to rubbing and washing, the colors should be subjected before the treatment with soap to a solution of 1 lb. of bichro-

mate of potash and 5 lbs. of acetic acid in ten gallons of water. The dyed leather is drummed or kneaded in this solution for fifteen minutes and then rinsed thoroughly.

Dyeing by means of a brush is the method employed where only one side of the leather is to be colored. For this purpose a solution of 1 to 2 lbs. of dyestuff and the above-mentioned ingredients per 10 gallons of water are used. This solution is brushed onto the dry leather until it has a good even appearance. The skins are then exposed to the air a few minutes and the following solution is then brushed on: 4 ozs. of bichromate of potash and 2 lbs. of acetic acid in 10 gallons of water. The leather is then washed and treated with the soap solution or the mixture of soap and eggyolk.

2. The dyeing of chamois leather is not so simple a process as the dyeing of vegetable-tanned skins. The oil-tanned fibers do not take up the dye at all readily unless the skins have been previously mordanted. The most common mordants used for this class of goods are chrome alum and bichromate of potash, and alizarine dyes are often used. The chamois leather to be ready for dyeing must be suitably prepared and mordanted. First, it must be wet back with warm water, and the next process is the removal of the excess of oil. For this purpose the goods are drummed in a solution of washing soda at 95° F. An excess of washing soda is not very harmful unless the temperature is too high, a suitable strength being about 2 per cent. When the grease has been removed in this way, the goods may be lightly fat-liquored and dried out. If the skins are for light shades they can be bleached with sodium peroxide and sulphuric acid, or with permanganate of potash and sulphurous acid. When the goods have been dried they are fluffed on one side and again wet down. Mordanting with chrome alum follows. This is best done in the drum. The chrome alum is dissolved so as to make a $1\frac{1}{2}$ to 2 per cent. solution, and enough of this liquor is placed in the drum with the goods, about 25 gallons being sufficient for six dozen skins. Drumming is continued until the chrome alum has entirely penetrated the thickest parts,

which usually takes from thirty to forty minutes. When the mordant has penetrated the goods, they are ready to be dyed. For this purpose it is customary for the dye to be added to the mordant bath without running it away, but it is better to remove the goods from the mordant bath and to give a fresh dye bath.

As has been already said alizarine colors are used for this class of goods. The dyestuff should be dissolved in boiling water, and the color is best developed by the addition of bisulphate of soda at a temperature of 115° F. Half of the dye to be used is added to the drum and the goods are drummed twenty minutes. The bisulphate of soda is then added, in quantity about twice the weight of the dyestuff used, along with the remainder of the dye. Drumming is continued twenty minutes when the goods should be thoroughly dyed, the color having penetrated completely through the fibers. After fat-liquoring and drying the goods are ready for finishing. The quantity of dye required for one dozen skins is about 2 ozs. of the powder dyestuff or about 10 ozs. of the paste dye.

The skins should be as smooth and clean as possible before they are colored so that after-coloring is not necessary. Only sufficient buffing should be done after coloring to give the skins a nice nap.

Bleaching.—1. Chamois skins may be bleached by exposing them to direct sunlight. They are first treated in a two per cent. solution of a neutral soap, then wrung out, rinsed and exposed to the sun for a day. A second washing with a 1 per cent. soap solution is now given ; the skins are rinsed and again exposed to the sun. The process of washing with the soap solution and exposing to the sun is repeated until the skins are bleached satisfactorily. Washing may be done with soda, but this has a tendency to make the leather harsh ; soap is therefore preferable.

2. Chamois leather is bleached rapidly and uniformly by immersion first in a solution of permanganate of potash and then in a sulphurous acid bath. Before it is bleached, the excess of

oil must be removed by washing in a lukewarm 2 per cent. solution of a neutral soap; the skins are then rinsed and wrung out. The solution of permanganate of potash is prepared by dissolving 1 lb. of permanganate of potash in 5 pints of water. Enough of this solution is added to water in a tub to color it a deep violet color. The bath is then warmed up to 100° F., and the skins are placed in it, one at a time, and stirred about in the bath for twenty minutes, at the end of which time they will be found to be thoroughly permeated with the solution.

This first bath can also be prepared by using 1 oz. of the potash for each dozen skins. Then about one-fourth the weight of potash of sulphuric acid is added and the skins are thrown in. Taken from the bath of permanganate of potash the skins are rinsed in cold water and placed in a solution of sulphurous acid. The tub should contain water into which gaseous sulphurous acid is either conducted from a steel cylinder, or aqueous sulphurous acid is added until the brown color of the skins has disappeared and the skins are bleached. The goods are stirred about in a sulphurous acid bath fifteen or twenty minutes or until they are white; they are next rinsed in cold water to remove the sulphurous acid and are then hung up to dry.

Sulphurous acid may be prepared from bisulphite of soda and acid. Dissolve 14 lbs. of the soda in 15 gallons of water. Into another vessel containing 2½ gallons of water pour 6 lbs. of muriatic acid and mix well. The skins are placed in the solution of bisulphite of soda and the diluted acid is added slowly until the skins are bleached throughout. They are then washed thoroughly, dried and finished.

The second bath may be prepared by adding 3 per cent. of bisulphite of soda to sufficient water or about 3¼ ozs. per dozen skins; and after the goods have been in the solution fifteen minutes, muriatic acid, one-third of the weight of the soda, is diluted with water and added slowly to the liquor. After the skins have been bleached and washed, they are washed in a solution of white castor oil soap or olive oil soap and are

then dried and finished by staking and pumicing. A wash of starch or pipe clay stirred into cold water is also sometimes used. Another softening mixture consists of 20 parts of oleate soap and 1 part of dextrine dissolved in 100 parts of warm water, and 40 parts of castor oil stirred thoroughly in. When cold, 2 parts of rice starch and ½ part of lithopon are added. This mixture applied with a brush to the skins after they have been washed restores the softness lost during the bleaching process.

Roller Leather.

This leather is made from lambskins tanned with bark. The qualities it must have to be satisfactory are level substance, clear and perfect grain that has no scratches, scars or cuts, smooth feel and pliability with a certain degree of firmness. Only the best skins should be selected. The leather must be perfectly smooth on the grain or the cotton thread used by the cotton spinners, who use this class of leather, when it is drawn between the rolls, one of which is covered with leather, will keep breaking. As a light color is essential, only clean, light-colored bark liquors can be used. The natural grease contained in the skins must be removed since the edges of the leather covering the rolls are cemented together before being slipped onto the roll, and if there is grease in the leather the cement will not hold.

The preliminary tanning is done in weak bark liquor. The skins are then pressed with a hydraulic press in layers between iron plates and sprinkled with sawdust to remove the grease. They are then taken apart and paddled in a weak liquor and drummed in warm salt water until all press-creases have disappeared.

The skins are tanned by being suspended in the liquor since a smoother grain is produced in this manner than when a paddle or a vat is used. The liquor is composed of oak bark and extract of increasing strength, in which the skins remain two or three weeks, when they are hung up and dried. When dry, they are stored away until they are to be finished. The

longer the skins are kept in the dry condition the better they are when finished.

When the leather is to be finished the skins are sorted. Those that are not as perfect as they should be are finished into fancy leather. The roller skins are then dampened and shaved. The shaving must be accurate in order that the skins will be of even substance. However, the skins do not all have to be reduced to the same thickness as some of the roller manufacturers make three or four different substances. After shaving, the skins are drummed in a sumac solution, and then they go back to the tan again to receive a stronger liquor. After being rinsed in water and drained, the skins are struck out on the flesh and tacked out to dry. When dry, they are taken off the boards and softened, then trimmed and seasoned with milk and albumen, dried and rolled, perched by hand, and next reseasoned and glazed. The finished skins are then marked with a frame on the flesh side and trimmed with a pair of shears. As every hair must be removed, the skins are wiped over with a cotton wool pad to find the remaining hairs, which are removed very carefully so as not to break the grain. The skins are then ironed, sorted and put into grades and sizes. The processes, of course, are not always followed exactly as outlined since those who make the leather change the process here and there in accordance with the best results obtainable.

Oak bark makes better roller leather than hemlock, since it contains less filling matter and produces lighter-colored skins.

The Tanning of Woolskins.

Soaking, Washing and Scouring.—Sheepskins that are to be tanned with the wool on should be good, fresh skins. Old, stale skins should be avoided as the wool is apt to slip, for which there is no remedy. The skins should be trimmed to remove the parts that are of no value, then fleshed and washed. After the pelts have been washed, which is best done in a wash wheel supplied with running water, they should be run through a burring machine, which removes all the burrs,

twigs, etc. Copper sulphate is of assistance in soaking dry pelts, 1 oz. to 15 gallons of water being sufficient, it acting as a germicide. Some skins require merely to be washed with borax and soft soap; others need thorough scouring. Scouring is done for the purpose of making the wool as clean and white as possible before they are tanned. It is much easier to wash the wool clean before than after tanning, since the alum and salt and other tanning materials set the dirt and grease and make their removal more difficult.

Scouring is done by laying the skins on a sloping table, applying the scouring solution first to the flesh and then to the wool. The scouring liquor may be made of strong solution of soft soap, to which a little carbonate of ammonia is added; or it may be a solution of soap, soda ash and salt made in the following manner: Add two bucketfuls of soft soap to 50 gallons of water in a vat or tub, then put in one half pailful of soda ash; turn on steam and boil the soap and alkali until they are dissolved; add one pailful of salt and enough water to make 200 gallons of liquor. The salt helps to bleach the wool and it also counteracts the caustic action of the soda ash.

The scouring liquor is first well worked into the skin with a brush, after which it is poured into, and worked thoroughly throughout the wool. The skins are next placed in waste scouring liquor, rinsed in warm water, and then scoured again as much as they seem to require. They are then rinsed in water until they are free from soap, next wrung out or drained thoroughly, after which they are tanned.

Liming.—The following process of liming works very satisfactorily: A solution of 1½ per cent. of caustic soda is made into a thin paste by the addition of French chalk, china clay or some other inert material of this description. This paste is applied to the flesh side, the skins folded up, flesh in, and allowed to stand four or five hours. They are then thrown into a 4 per cent. solution of calcium chloride (4 lbs. of calcium chloride per 10 gallons of water) and left several hours, usually over night. The pelts should then be washed in

water in the drum and delimed with lactic acid. About 4 ozs. of lactic acid per dozen skins is usually sufficient. The skins are now ready for tanning.—From the "Leather Trades Year Book."

Tanning.—The tanning may be done with a paste of alum, salt and flour. Heat 2 gallons of water until it is near boiling point, and stir in powdered alum until the solution is very puckery to the taste. Add one-half as much salt as alum and allow the solution to cool. Mix some flour with water and add the paste to the alum and salt liquor. This tanning paste makes the flesh nice and white. If yellow color is wanted, add 1 lb. of gambier to the paste, the same having been dissolved separately.

The skins are spread on a table, flesh side up, and the paste is spread on evenly, being applied liberally. The skins are then laid flesh to flesh, or folded half over the other half, and left until the next day. The paste should be applied every day for a few days. The skins should then be hung up to dry and as they dry be worked and staked until they are soft and dry. One pound of rolled oats can be used in place of the flour, the solution of alum, salt and oatmeal being boiled several minutes. The wet skins can also be tanned by using a mixture of powdered sulphate of alumina and salt, 2 parts of the former and 2 parts of the latter, or a mixture of powdered alum and salt. This mixture can be used dry and rubbed into the flesh side of the skins every day for several days, when the skins will be fully tanned.

Another way to tan the skins is to dissolve 8 ozs. of sulphate of alumina and 6 ozs. of salt in a gallon of warm water and applying several coats of the solution.

A convenient way to tan the skins is to stretch them into frames and to apply the paste or dry powder to the flesh side.

Alum-tanned skins, before drying, should be given a solution of soap or stearine which serves to fix the tannage so that it cannot be so easily removed by washing. Tanning can also be done by immersing the skins in a solution of alum and salt, then drying them. Flour added to the tanning paste makes the skins softer and whiter.

After the skins are dry and soft it is advisable to rescour them. This should be done on a table in about the same manner as before tanning.

Bleaching.—A permanent white can be obtained by bleaching the skins with peroxide of hydrogen. The bleaching bath is prepared as follows: Enough sulphuric acid is added to water in a tub to make a 1 per cent. by weight solution or 10 lbs. of acid to 100 gallons of water. To this acid solution 7 lbs. of sodium peroxide are added, whilst the solution is being constantly stirred. The liquor is then tested with litmus paper, and peroxide or acid is added as required until the solution is quite neutral; 4 lbs. of silicate of soda previously dissolved are then added. The skins are stirred about in this liquor for one hour; then taken out, passed through or scoured with a weak solution of sulphuric acid, washed, drained, retanned if necessary, degreased and dried. When dry, they are softened and run on an emery wheel to clean the flesh. Retanning is done by applying a solution of alum and salt to the flesh sides.

Bleaching may also be done with permanganate of potash and sulphurous acid. The skins are washed and placed in a solution of permanganate of potash made by dissolving $1\frac{1}{10}$ lbs. of the same in 120 gallons of water warmed to 95° F. The skins are stirred about in this solution until the wool is a good, rich brown. They are then removed and drained, and next placed in a bath of bisulphite of soda, made of 120 gallons of warm water, $7\frac{1}{3}$ quarts of bisulphite of soda and $6\frac{2}{3}$ lbs. of muriatic acid. In this liquor they are worked until they are sufficiently bleached. They are then rinsed, dried and finished.

Degreasing.—Most of the grease in the skins may be removed by plastering the flesh side with a paste made of whiting and water. The skins are tacked out wet and the paste of whiting is applied. The skins are then placed in a warm room and dried. The grease is absorbed by the whiting. The plaster should be scraped off and another coat applied. This should be done until the paste dries clean and white. The flesh is

then washed clean and a mixture of alum and salt applied to replace the tanning material removed by degreasing and washing.

Some grease may be removed by brushing the skins with benzine, then rinsing off with hot sumac liquor.

Degreasing may be done with benzine in the following manner: Have a wooden tray about one foot deep, three feet wide and four feet long, with a rack about an inch thick to cover the bottom to keep the skins off the bottom of the tray. Only the leather should lay in the benzine. The lid of the tray should be made to fit in a slot and be filled with water to prevent the evaporation of the benzine. The skins are then dried and finished.

Tanning with Formaldehyde.—The skins limed and then delimed with lactic acid may be tanned with formaldehyde. For each 100 parts of pelt use 1 part of formaldehyde, i. e., about 2½ parts of commercial formaldehyde in a convenient quantity of water, so that the skins can be immersed in the solution. The skins are left in from twenty-four to forty-eight hours, then neutralized by washing in a bath containing carbonate of soda or borax or a mixture of ammonium sulphate and carbonate of soda, washed in clean water, drained and fat-liquored with a solution of 3 parts of soft soap in 60 parts of water, then dried and finished.

Tanning with a Mineral and Vegetable Tannage.—The formula for this process of tanning is: Aluminum sulphate, 5 lbs.; common salt, 5 lbs.; gambier, 2 lbs.; rye flour, ⅝ lb.; water, 10 gallons.

Dissolve the aluminum sulphate and salt in a small quantity of water. Also dissolve the gambier by boiling in a little water. Mix the two solutions. The rye flour is made into a smooth paste with a little warm water and the alum, salt and gambier solution added to the paste, the whole being thoroughly stirred together to a thin paste-like mixture. This mixture is applied to the flesh side of the skin with a brush, applying a coating of about one-eighth inch in thickness, afterwards folding the skins into cushions. The goods, after

lying some time in the wet condition, are hung up and dried. It is said of this method of tanning that it gives skins that are soft and flexible and that the tannage is more durable than the alum tannage.

Sheep pelts can also be tanned by a chrome process by the methods described for furs and hair skins.

Tanning with Gambier.—To tan woolskins with gambier, first tan them with alum and salt and then put them into weak gambier liquor. The dry powdered alum and salt should be rubbed into the wet skins, two applications being required. The skins are then tanned with the gambier. The addition of 1 lb. of picric acid for 50 skins to the gambier liquor colors the wool a light yellow. The liquor should be rather weak at the start and strengthened until the skins are tanned through. It is said that alum-tanned skins can be colored a light yellow by immersing them in a solution of picric acid previous to tanning. After they have been scoured and rinsed, put the skins into a bath of fifteen pailfuls of warm water to which have been added 4 ozs. of picric acid dissolved in a little water and one tumblerful of sulphuric acid. The skins should be moved backward and forward for fifteen minutes, then rinsed in water and tanned with alum and salt.

Tanning with Alum, Salt and Hemlock Extract.—Skins tanned in this process and then scoured and passed through a weak bath of sulphuric acid are made a golden-brown color that is desirable for some purposes. The pelts are soaked and scoured before tanning, special care being taken to get the wool clean. The tanning liquor is made of alum, salt and extract of hemlock bark; it is quite weak at the start and strengthened as the tanning proceeds. Some potash soap should be added to the stronger liquor to help turn the wool and give the skins a velvety feel. After the pelts are well tanned they should be drained off and oiled on the flesh with a good quality of mineral oil, applied warm, and then hung up to dry. When dry they are scoured with a strong solution of potash soap and white soda ash. Both wool and flesh are scoured. The scouring suds are thoroughly rubbed into the wool and washed

out again, the operation being repeated two or three times. This scouring darkens the wool. A weak solution of sulphuric acid is thrown onto the wool after it has been rinsed free from suds. The sulphuric acid liquor is made by adding enough acid to water to make the water sharp and sour; it should be rubbed thoroughly into all parts of the wool. It changes the color of the wool to a light golden brown. The wool is next given a good blowing-out with water from a hose and made as clean as possible, and the skins are then hung up to dry. Finishing consists of dampening, arm-crutching, buffing on the flesh side and beating the wool soft and clean.

Coloring.—Woolskins and shearlings may be colored any shade of color by the application of basic or acid dyes. Basic colors, however, are used chiefly upon the cheaper grades of skins and where no particular demands are made for fastness to rubbing and washing. Where fastness is essential the acid dyestuffs should be used; and in order that the skins may withstand the high temperature requisite for dyeing, they should first be subjected to a chrome tannage.

When acid dyestuffs are used the process of coloring is as follows: The skins are retanned with one-bath chrome tanning liquor. A solution of 5 lbs. of chrome alum in 10 gallons of water, to which ½ lb. of formaldehyde has been added may be used. The temperature of the solution should be 70° F., and the whole of the flesh side should be exposed to the liquor. After two or three hours the skins are lifted out and a solution of 14 ozs. of soda ash is added to the chrome liquor; the skins are put back and left in from twelve to twenty-four hours and even longer if thick and heavy. They are then rinsed. Any chrome liquor may be used, but in any case it is advantageous to add ½ lb. of formaldehyde to 10 gallons of liquor, which increases the resistance of the leather to heat.

In order to increase the affinity of the wool for the dye, the skins are subjected to a chlorinating process, a treatment with chloride of lime. While they are wet they are immersed for fifteen minutes in a cold bath containing 1 lb. muriatic acid in 10 gallons of water. Then, without rinsing, they are put

into a cold chloride of lime bath to which is gradually added, in four portions, the clear solution of from 8 to 14 ozs. of chloride of lime per 10 gallons of liquor. After one hour in this bath, the skins are reentered into the first bath in which they are worked another fifteen minutes. They are then rinsed in lukewarm water charged with about 3 to 5 ozs. of hyposulphite or thiosulphate of soda or bisulphite of soda per 10 gallons of liquor in order to remove the last trace of chlorine. After pressing or hydroextracting, the skins are ready for dyeing.

The dye bath contains the solution of acid dye, 10 to 20 per cent. of the weight of the goods of Glauber's salt crystals and 2 to 5 per cent. acetic acid, the temperature of the bath being 120° F. After the skins are in the bath the temperature should be raised gradually to 165° F. After one-half hour add 8 per cent. bisulphate of soda in two or three portions, working at the same temperature for another thirty minutes. Then rinse thoroughly and hydroextract. In order to impart a soft feel to the wool the skins may be treated after the rinsing with a solution of 1 lb. olive oil soap, 2 ozs. olive oil and 1½ ozs. ammonia per 10 gallons of liquor for fifteen minutes; they are then dried without further rinsing.

Black is dyed with Naphthylamine Black S, ESN, SS2B, Naphthylamine Blue Black B, BD, Naphthol Black, also Azo Merino Black B (Cassella). Of these dyestuffs 4 to 6 ozs. calculated on the dry weight of the skins are required to produce a deep black. Where basic colors are used it is advantageous to treat the skins with acid and chloride of lime as described for acid dyes, then rinsing them and passing them through a solution of tanning material, say, 2 ozs. of sumac, hemlock, cutch or quebracho extract, dissolved in water, immersing for half an hour, then washing and coloring; 1 oz. of basic dye is generally sufficient for two skins. To the solution of dye ½ oz. acetic acid and 4 ozs. Glauber's salt should be added. The temperature of the dye bath should be from 100° to 110° F. Good, fast shades of color are also produced by immersing the skins in a bath of sumac, hemlock or quebracho for one-half hour, next immersing in a solution of titanium-potassium

oxalate and then coloring with basic dye, 2 ozs. of the tanning extract and 1 oz. of the titanium salt being sufficient for two skins.

To get a slight gloss on the wool, the skins should be passed through a weak solution of soap and oil, then dried and finished. Six gallons of stock soap and oil mixture are made by boiling 6 lbs. of soap and 18 lbs. of oil and making up to 6 gallons, $\frac{1}{8}$ pint of this mixture for two skins being added to 10 gallons of hot water, and the skins, flesh to flesh, are passed through the bath, then dried, softened and finished.

A good shade of tan is obtained by putting the skins, after washing from the tannage, into a sumac bath for one-half hour, 2 ozs. of sumac being used for each pair of skins; next allowing the skins to drain, and then immersing them in a bath of titanium salt, 1 oz. for two skins. This produces a yellowish-brown color. Any shade of color can be obtained upon skins treated as described by using 1 oz. of basic dye, $\frac{1}{2}$ oz. of acetic acid and 4 ozs. of Glauber's salt for every two skins. Colors produced by acid dyes are faster to rubbing and washing than colors obtained by using basic dyestuffs.

Dyeing Woolskins Black. In addition to the method of dyeing woolskins black with acid dyestuffs that has been described, a good black can be secured by dyeing with logwood, fustic and bichromate of potash. The skins should be scoured and rinsed well before they are colored. The first bath may consist of $\frac{1}{2}$ lb. of bichromate of potash dissolved and added to 10 gallons of water at 100° F. The skins are doubled, flesh side in, and immersed in the solution; then removed and drained.

The second bath consists of strong logwood liquor to which some fustic extract and some ammonia have been added, $1\frac{1}{2}$ lbs. of logwood crystals, 4 ozs. of extract of fustic and 1 pint of spirits of ammonia being used for 10 gallons of liquor. The temperature of this bath should be 120° F., and the skins should remain in it until every part has been colored; they should then be drained and immersed in a bath of 1 lb. of bichromate of potash in 10 gallons of water. After the skins

have been passed through the liquor they should be drained and the wool should receive an application of kerosene oil, well rubbed in, drained, washed, dried and finished.

Another process of dyeing woolskins black is as follows: For one dozen skins a bath is prepared of 80 gallons of water, 20 lbs. of logwood extract, 3½ lbs. of fustic extract and 2 lbs. of verdigris or copper acetate. This bath is heated to 110° F., and the skins are allowed to remain in it 3 or 4 hours, the same temperature being maintained during the process. 2½ quarts of acetate of iron are then added to the bath and the skins are left in the liquor and stirred about occasionally until they are dyed black, which usually requires an immersion of thirty or forty hours.

The skins are then drained and allowed to oxidize at least twelve hours; they are then washed in warm water and scoured with a solution of soft soap and carbonate of ammonia, next washed and drained, retanned with alum and salt and stretched in frames to dry. This treatment after dyeing is necessary if a jet black is to result. To obtain more gloss on the wool the skins are passed through a hot dilute soap and oil solution, then dried and softened.

Semi-Chrome Leather.

Semi-chrome leather, as the name implies, includes those leathers which are tanned partly by a vegetable tanning process and partly by a process of chrome tanning. The two processes may be carried out together, or consecutively, or the chrome process may be used as a retannage for vegetable-tanned skins. Usually the chrome process follows the vegetable process since this procedure gives the leather its characteristic properties.

Among the skins that arrive in this country in a partially tanned condition are sheepskins from East India, South Africa, South America and Australia. It is these skins, particularly those from East India, that are given the chrome retannage. The goods are sorted according to substance, tannage, etc., and then marked. After marking, the skins are equalized

by splitting or shaving. The larger skins are split and, if necessary, are shaved. Before splitting or shaving, the goods are dampened down by immersing the thick portions in warm water and finally the whole skin. Very light skins are dampened back by being drummed with warm water in the drum for ten minutes. Finally they are laid in a pile for a few hours to become uniformly soft and moist.

Splitting and Shaving.—In splitting the goods should be left thicker than the final product is required and then shaved down to the required substance. The flesh splits are used for welting purposes, heels, linings, etc.; the grains are detanned and then retanned with chrome liquor. Unless most of the original tannage is removed the leather will be hard and unevenly tanned.

Stripping the Tannage.—Stripping or detannage is accomplished by means of the milder alkalies. Caustic soda should not be used as it is too energetic. Borax may be used with advantage because it acts gently and gives a smooth grain to the skins. For light skins 2 per cent., and for heavy skins, 2½ per cent. of borax is used calculated on the weight of the drained goods. If washing soda is used not more than 2 lbs. should be used for 100 lbs. of leather. The drained skins are placed in the drum with warm water at 100° F., the drum is set in motion and the borax or soda solution is run in through the hollow axle. The drum is allowed to run thirty minutes, which is usually sufficient to remove the greater part of the tannin. The washing should be continued until the skins have a soft and slippery or semi-gelatinous feel. When this has been accomplished the liquor is allowed to run out and warm water is run in to wash the skins. This washing is continued until the water coming from the drum is quite clear, showing that all dissolved tannin is removed. In order to neutralize the alkali retained by the leather ½ to 1 per cent. of formic acid is added to the wash water. The progress of the neutralization may be followed by applying to a cut section of the skins a piece of blue litmus paper. If the paper is colored a feeble red the neutralization is complete. A final

washing with pure water prepares the goods for the chrome retannage.

Chrome Retanning.—This process is best carried out by using a one-bath liquor. A commercial concentrated chrome extract may be used, or a solution of chrome alum prepared in the tannery. A satisfactory liquor is made as follows: Dissolve 8 lbs. of chrome alum in 10 gallons of water. Add to this solution 3 lbs. of soda crystals or 20 ozs. of soda ash dissolved in 1 gallon of water. This is sufficient for 100 lbs. of skins.

The one-bath chrome liquor can also be prepared by dissolving 10 lbs. of bichromate of soda in 2 gallons of water, adding to this 10 lbs. of sulphuric acid, then slowly 6 lbs. of syrup glucose, waiting after each addition of syrup for the agitation to subside. This liquor when diluted to 45° Bé. will contain 10 per cent of chrome oxide, and from 12 to 15 lbs. of it will tan 100 lbs of skins.

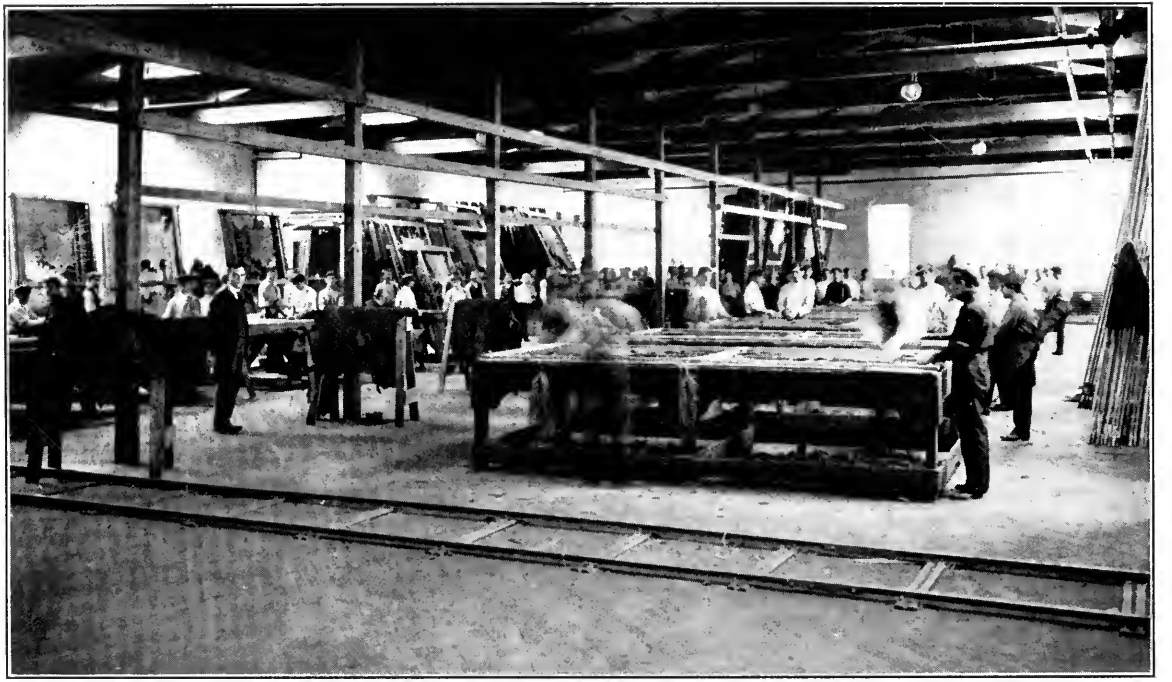
The process requires from three to eight hours in a drum; the skins are then removed from the liquor and horsed up grain to grain for twenty-four hours to complete the tannage of the fibers; they are then neutralized.

Neutralization.—The complete neutralization of the leather is accomplished by washing it in a 1 per cent. solution of washing soda for one-half hour. At the end of this time a cut section of the skins is tested with blue litmus paper. If the paper becomes red there is still too much acid and then a solution of ½ per cent. soda and ½ per cent. ammonium sulphate, calculated on the weight of the leather, is added and the skins are washed twenty minutes. The goods are next washed thoroughly in tepid water and are then ready for dyeing. It is practicable to stain the flesh of the leather during the chrome tanning by adding a solution of nigrosine or other suitable black to the chrome liquor.

Dyeing.—The dyeing of the leather black is best accomplished by using a logwood liquor and a direct leather black in the same manner as upon regular chrome leather. Acid blacks can also be used, in which case it is advantageous to

add a solution of sumac or gambier to the liquor to impart greater fullness to the leather. The process is the same for straight chrome-tanned sheepskins.

Fat-liquoring.—The best results of this process are secured by using an acid fat-liquor or a mixture of eggyolk and neats-foot oil as directed for chrome goat and sheep leather. The leather is then dried, staked, glazed for bright finish or ironed for dull finish; and if the work has been properly done the finished leather is soft and well-tanned.



STRETCHING LEATHER IN FRAMES BEFORE FINISHING IT.

To face page 99

SECTION TWO.

The Manufacture of Calfskin Leathers.

The processes through which calfskins are passed before they are tanned into leather are Soaking, which cleanses and softens them; Liming or Depilation, which loosens and removes the hair and dissolves the perishable matter so that it can be removed; Deliming or Bating, which accomplishes the removal of the lime and alkaline sulphides acquired during the preceding process; and finally Pickling, which puts the skins into a clean and receptive condition for the tanning liquor as well as preserves them from decay.

There are also mechanical and manual operations, such as trimming, fleshing and working out, to remove the parts and substances that are superfluous and objectionable. Broadly speaking, these processes, which constitute the beamhouse work, are about the same for all soft and supple tannages, chrome or vegetable. Practical working instructions for preparing the skins for tanning follow.

Soaking Green-salted Skins.—The soaking of green-salted calfskins should be done in clean, fresh water. As good a method of soaking as any that can be followed is to shake the skins free from salt, trim off the useless portions, and then put them into the water for twenty-four hours. The remaining salt and dirt are next removed by washing the skins for fifteen minutes with running water. Light skins are then fleshed and put into a liming process. Heavy skins are resoaked twelve hours and then passed into the lime liquors.

Soaking Dry Skins.—Calfskins that are received at the tannery in a hard, dry condition require thorough softening before they can be limed and unhaired. Sulphide of sodium is an effective softener of such skins. Dissolved and added to

the water in which the skins are soaked, it hastens the softening and freshens up the withered fibers and grain; 1 lb. of the material may be used for each 100 gallons of water in the vat. When the skins have become flexible in the soak they should be taken out and run dry in a drum for a half hour, then put back into the water and soaked twenty-four hours longer. If they are not perfectly soft at the end of the time stated they should be placed in piles over night and then resoaked in clean water for twenty-four hours. They are next trimmed and fleshed and put into the lime.

In place of sulphide of sodium, formic acid may be used in the soaks. For 100 parts of skins 5 parts of the acid are used in 1000 parts of water; some salt may advantageously be added also. This process takes from two to five days according to the substance and condition of the skins. The softening can be hastened by running the skins in a drum but this should never be done until they are soaked through and fairly pliable in the soak. Upon coming from the acid soak the skins are fleshed and then put into the lime solutions.

Liming and Unhairing.—1. After calfskins have been soaked and fleshed they are put into the lime process. For light skins, liming according to the following directions will be found satisfactory in every respect, the skins being brought into condition for unhairing in four or five days. For each 100 lbs. of skins 5 lbs. of lime are used. It is thoroughly slaked and added to the water in the paddle, and to it 1 lb. of sulphide of sodium, dissolved in hot water, is added. The temperature of the liquor is then raised to 75° F.; the skins are thrown in and the paddles are run at intervals during the day. The next morning 5 lbs. of lime and 1 lb. of sulphide of sodium are poured into the liquor; and the skins, which have previously been hauled out, are put back and left in the liquor with occasional stirring one or two days longer, when the liquor is again strengthened in the same manner as before and warmed to 75° F., this temperature being maintained during the entire process. At the end of four days the skins should unhair easily, but it does no harm to leave them in

the lime one day longer. Heavy skins require another addition of sulphide of sodium and lime and two days more or longer in the liquor. The hair should come off easily without straining the grain. When taken out of the lime liquor the skins should be thrown into water at 85° F. for a half-hour, then unhaired carefully, washed and put into the bate.

2. Another satisfactory process of liming calfskins is carried out as follows: The quantities of lime and sulphide of sodium are for 100 lbs. of skins. The first lime contains 2 lbs. of lime and the skins are left in it twenty-four hours. The second lime contains 2 lbs. of lime and 1 lb. of sulphide of sodium, the skins remaining in the same twenty-four hours. The next day they are hauled out, the liquor is thoroughly plunged and the skins put back for twenty-four hours. The third lime is made up of the same quantity of lime and sulphide of sodium as the second lime; the skins are left therein twenty-four hours. The fourth lime contains 2 lbs. of lime, and is warmed to 80° F. The skins remain in this lime twenty-four hours, and from it they are put into clean water at 80° F., and after having been in it two or three hours are unhaired.

3. In this process of liming, lime and red arsenic are used; and the skins are brought into good condition for chrome or vegetable tanning. To start with, use a new lime made by adding 2 lbs. of lime, well slaked, to the requisite volume of water in the paddle. Leave the skins in this lime twenty-four hours. On the second day haul them out, plunge the liquor, and put the skins back. On the third day add 2 lbs. of lime, stirring the goods at intervals during the day. On the fourth day, haul the skins out and after plunging the lime, put them back. On the fifth day add 3 lbs. of lime, well slaked, and 1½ lbs. of red arsenic, slaked with the lime. On the sixth day simply haul the skins out and put them back, plunging the liquor well. On the seventh day add 3 lbs. of lime and 1½ lbs. of red arsenic, and warm the liquor with steam to 75° F. On the eighth day haul the skins out of the lime, warm the liquor as before, and put the skins back. The hair should

come off easily on the ninth day. After the hair has been removed, the skins should be washed in warm water, refleshed, and all the fine hair worked out. They are then washed and bated.

Red arsenic keeps the grain smooth and the skins flat; it also produces fine grain on the leather that takes a fine glazed finish. The lime and red arsenic should be mixed together dry and slaked with hot water. Place the limed skins in warm water containing 12 ozs. of borax to 100 gallons of water to soften the grain and dissolve the lime on the surface, so that the fine hairs and waste matter will come out readily when the skins are worked. The quantities of lime and arsenic in the foregoing process are for 100 lbs. of skins.

4. The use of a paste of lime and red arsenic is not customary among tanners of calfskins; yet such a method of unhairing, followed by liming for a few days, gives smooth, soft skins with fine grain and texture. The paste of lime and red arsenic should be prepared a day or two days before it is to be used. Mix 50 lbs. of lime and 2 lbs. of the arsenic and slake together with hot water. The mixture should be stirred whilst it is slaking and enough water added to make it as thick as paint. The skins are spread out upon the floor or upon a table and the prepared mixture is spread upon the flesh side with a brush, the skins folded down the middle lengthwise, and placed in piles in a vat. When the vat is about three-fourths full, some boards weighted with stones are placed upon the skins and the vat is filled with water. After five or six days, the skins are taken out of the vat, washed and unhaired. Some skins require from six to eight days before they can be unhaired. The next process is liming.

For each 100 lbs. of skins in the lot, use 14 lbs. of lime and 5 lbs. of red arsenic; 1 or 2 lbs. more of lime and a little more arsenic may be used for soft leather. The skins are limed from three to seven days, according to the thickness, being stirred by the paddles three to four hours each day. Having been thus limed, the skins are next washed and bated.

Notes.—After they have been unhaired the skins should be

placed in warm water a few minutes and then worked over the beam, the grain being thus made soft and clean. They are next rinsed in warm water and then pickled. It is advisable to take the white hair off by hand and keep it separate from the colored hair taken off by the machine. The white hair fetches a higher price than the colored and this more than repays the cost of keeping the two kinds separated.

5. The following method of liming with lime and sulphide of sodium produces good grain and full feel without much loss of skin substance, and it is therefore a good process to use in preparing calfskins, kips, etc. from chrome tannage. When once started the movement described entails only a small amount of handling of the stock. The quantities of lime and sulphide of sodium used are based on 100 lbs. of wet skins. A still pit or a paddle may be used, preferably the latter. By calling the pits A, B, and C and numbering the packs, the method of procedure may be readily understood. The temperature should be maintained at 70° F. First day. Pack No. 1 is put into Pit A, containing 5 per cent. lime and 1 per cent. sulphide of sodium.

Second Day. Pack No. 1 is transferred to Pit B containing 5 per cent. lime and one per cent. sulphide of sodium. Pack No. 2 enters Pit A, once used.

Third Day. Pack No. 1 is transferred to C containing lime and sodium A and B. Pack No. 2 is placed in B liquor, once used. Pack No. 3 is put into Pit A, twice used.

Fourth day. Pack No. 1 removed. Pack No. 3 is drawn from A, and new liquor consisting of 5 per cent. lime and 1 per cent. sodium sulphide is made up within that pit. Pack No. 2 is transferred to A. No. 3 is placed in C, once used. Pack No. 4 is put into B, twice used.

Fifth day. Pack No. 2 is removed. Pack No. 4 is drawn from B and a new liquor prepared as before. Pack No. 3 is transferred to B. Pack No. 4 is placed in A, once used. Pack No. 5 enters C, twice used.

Sixth day. Pack No. 3 is removed. Pack No 5 is drawn from C and a new liquor is prepared. Pack No. 4 is trans-

ferred to C. Pack No. 5 is placed in B, once used. Pack No. 6 is transferred to A, used twice.

On removing the stock from the liquor it should be thrown into water at about 85° F. for one-half hour, and then unhaired on the machine or over the beam ; it is then bated. Care must be taken that the skins are not bated too low, otherwise a loose grain may result. The above-described method of liming is used by the Tannery School of Pratt Institute, Brooklyn, N. Y.

Bating.—For all kinds of soft, pliable leather into which calfskins are tanned, no matter whether the tannage is chrome, vegetable or alum, it is necessary to thoroughly rid the stock of all lime and alkaline sulphides which they acquire in the process of liming and unhairing. This is accomplished by the process commonly called bating or puering. During this process the skins lose their hard and swollen condition and become soft, thin and clean and receptive to the tanning materials. Several practical and efficient processes of bating will be described. Skins worked through any one of these processes according to the instructions given will be satisfactory in every respect.

1. In this process oropon, a commercial bate, is used, 8 ozs. of it being generally sufficient for 100 lbs. of limed skins. It is dissolved and added to water in a paddle at 100° F. The skins are turned from time to time and allowed to remain in the liquor over night. The next morning they are soft and open and free from lime and ready to be pickled or tanned according to the tannage that is to be used.

2. Very satisfactory results are secured by bating calfskins with bran and lactic acid. Prepare a paddle with water at 120° F., and put into it 2 pailfuls of dry bran and allow it to stand over night. The next day bring the temperature up to 95° F., and add a ½ pint of lactic acid for every 100 lbs. of skins. Stir the liquor thoroughly ; throw the skins in and then add another ½ pint of the acid. Run the paddle three or four hours, then take the skins out and wash them in warm water.

For the second lot of skins run the liquor down about one foot and make up the loss with fresh water, brought up to 95° F., as before. Do not use any more bran but take 1 pint of lactic acid for 100 lbs. of skins and proceed as directed for the first lot. Continue in this way for six days, after which run out all the bate liquor and make up fresh liquor with hot water and 2 pailfuls of bran as in the beginning. The skins taken out of the liquor should be rinsed in warm water and then pickled and tanned.

3. This process consists of sour grape sugar and lactic acid. Take 100 lbs. of grape sugar or glucose and stir it into 35 gallons of hot water in a clean barrel. Allow this to stand for two days in a warm temperature to become completely soured. Prepare a paddle with water at 95° F., and put into it 5 pints of the sour sugar solution. For every 100 lbs. of skins to be treated take 1 pint of lactic acid and put half of it into the prepared liquor, then throw in the skins and add the other ½ pint of acid. Run the skins in the bate from three to four hours; then take them out and wash them. This simple washing is important if a good clear grain which will color easily is desired.

For the second pack of skins the liquor should be run down about twelve inches and the loss made up with fresh water. The temperature is brought up to 95° F., as for the first pack and 5 pints of the sour sugar solution are added, and 1 pint of lactic acid, as directed for the first pack. After this has been done for six days, run off all the liquor, retaining about a barrelful with which to mellow the new liquor.

The quantity of 5 pints of the sour sugar solution is based upon the volume of liquor in the paddle. The average capacity of a paddle is between 2000 and 2225 lbs. of skins. The action of the sugar, however, is so mild that a wide range in the weight of stock bated with 5 pints of the solution is permitted without any danger. The foregoing process is especially recommended for soft upper shoe leather.

4. In this process of bating sal-ammoniac and salt are used in the first liquor and formic acid and salt in the second

liquor. The result is perfectly delimed and pickled skins, the second bath serving as a drench and also as a pickle.

For each 100 gallons of water at 95° F. in the paddle use 3 lbs. of sal-ammoniac and 10 lbs. of salt. Paddle the skins in this liquor two hours, then leave them in over night. Sal-ammoniac and salt produce ammonia which bates the skins with no danger of injury to grain or texture.

The next morning transfer the skins to the pickling liquor, which is made by adding 1 to 2 lbs. of formic acid and 10 lbs. of salt to 100 gallons of water at 85° F. This drenches and pickles the skins. After an hour in this bath the skins are ready for tanning into chrome or vegetable-tanned leather. The formic acid in the pickle removes the last trace of lime and strengthens the fibers, which will then stand the corrosive action of the chemicals and acid used in chrome tanning.

5. This is also a reliable bran drench. Take a half-barrel of bran, add enough water to make it mushy and let it stand forty-eight hours to sour. When it is sour empty it into a vat half filled with water. Add 3 pints of sulphuric acid and 3 pecks of common salt, and heat to 95° F. This quantity of bating material is sufficient for 300 to 400 skins. Throw the goods into the liquor and paddle for four or five hours; then wash them in warm water if for black leather, or work them over the beam and then wash them, if for colored leather. This process produces soft and clean skins which can be pickled and tanned by any tanning process.

The next process is pickling with acid and salt.

Ammonium butyrate is one of the newer chemical products for deliming and bating. It is made by neutralizing butyric acid by ammonia. It produces the best results as a bate when it is used upon skins that are put into the tanning liquors in a soft or neutral condition. The skins become perfectly delimed, white and soft; and no injury results when an excess is used. It may be used alone or in conjunction with any other bate. For bating calfskins it is used alone, the quantity recommended being 1 lb. to 1½ lbs. for 100 lbs. of skins. The ammonium butyrate is dissolved and added to warm water in

the bating paddle. The goods are put in and paddled one-half hour; next allowed to rest for two hours and then paddled another half-hour, when they are taken out and either pickled or tanned.

Butyric acid is another chemical product of recent introduction. It may be used in the pickling of calfskins for chrome or vegetable tanning, especially for the two-bath process, when it is used in the following manner: The skins are bated with any satisfactory bate or in a bran drench and are then pickled in a drum with a solution of 10 lbs. of salt, 10 ozs. butyric acid in 15 gallons of water for 100 lbs. of skins. In this liquor the skins are turned one hour; they are then given the first chrome process, which in this case is made of 4 to 6 lbs. of bichromate of potash, 1 lb. of butyric acid and sufficient water, say 15 gallons. This method of pickling and tanning is said to produce leather having a particularly soft grain and agreeable feel.

Test for Deliming.—A simple test to ascertain whether skins are sufficiently bated and delimed is to touch a cut edge of the skin with phenolphthalein solution. If there is lime still present a violet coloration is produced; when the skin is entirely delimed there is no such coloration.

Pickling with Sulphuric Acid and Salt.—It is the general custom at the present time to pickle skins for chrome and vegetable tanning. When sulphuric acid is used the process is as follows: To 20 gallons of water in a barrel, 1½ lbs. of sulphuric acid and 12 lbs. of salt are added. The washed skins are placed in a drum, and the solution of acid and salt is poured in through the trunnion while the drum is in motion, and the drum is allowed to run one hour, when the skins are taken out, horsed up and allowed to drain. They are then in a condition to be tanned.

Pickling with Formic Acid and Salt.—Twenty gallons of water to which 10 lbs. of formic acid and 25 lbs. of salt have been added are used for pickling 100 lbs. of skins. The skins are put into the drum, which is then set in motion. The solution of acid and salt is poured in through the trunnion

and the goods are drummed one hour, then horsed up to drain.

Pickled skins, when tanned, have softer and firmer grain than those that are tanned without being pickled; the pickling bleaches, cleanses and preserves them. Pickled with either sulphuric or formic acid, the skins are ready for the tanning liquors.

Processes of Chrome Tanning.

Two-bath Process.—Weigh the pickled skins and for each 200 lbs. of them in the pack to be tanned use the quantities of chemicals and acid that are specified in the following instructions.

Six pounds of bichromate of soda, 4 lbs. of salt, 3 lbs. of muriatic acid and 15 gallons of water. Dissolve the soda in boiling water and pour the solution into the 12 gallons of water; then add the salt and acid. Throw the skins into the drum and set the latter in motion. Pour the prepared solution into the drum and run the latter from one to two hours. Then place the skins over horses over night to allow for draining and for the chrome to become fixed in the fibers.

The next morning prepare a ten per cent. solution of bisulphite of soda and dip the skins one at a time into this solution; then throw them into the drum. Dissolve by boiling 12 lbs. of hyposulphite of soda and pour the solution into 12 gallons of water. Add to the hypo solution 3 lbs. of salt and 6 lbs. of muriatic acid.

Drum the skins with this liquor two hours; then horse them up over night. The next day neutralize, wash, and shave the leather.

2. In this process of chrome tanning sulphuric acid is used in the first bath instead of muriatic acid, and bisulphite of soda as the reducing agent of the second bath instead of hyposulphite of soda and acid.

The skins are drummed from one to two hours in a solution of 6 lbs. of bichromate of soda, 2 lbs. of sulphuric acid and 4 lbs. of salt in 15 gallons of water; they are then horsed up until the next day.

The second part of the process is the use of a solution of 6 lbs. of bisulphite of soda in 15 gallons of water. The drumming in this liquor is continued for from one hour to two hours or until the skins have assumed a light blue color throughout the thickest parts. After draining twenty-four hours, the leather is washed, neutralized and shaved.

It is immaterial whether bichromate of soda or of potash is used in the first bath. Bichromate of soda is more deliquescent than bichromate of potash, but it is less so now than formerly and costs less than the potash salt.

One-bath Process.—The simplest way to produce chrome leather from the pickled calfskins is by the use of concentrated one-bath material, such as tanolin, 6 lbs. of this material being used for 100 lbs. of skins. It is dissolved in 2 gallons of boiling water, and the solution is divided into three portions, that is to say, one-third of it is poured into the drum at a time. The skins are first drummed for fifteen minutes with 8 gallons of water in which 6 or 8 lbs. of salt have been dissolved. One-third of the chrome liquor is then poured into the drum and the stock is run one-half hour; then another one-third is added and the drum is run another half-hour; finally the last portion is used and the skins are then drummed one hour. Eight ounces of bicarbonate of soda are dissolved in a little water and poured into the drum, which is then run two hours; next 6 ozs. more of the soda are added, and the stock is drummed until it is fully tanned, usually one hour longer. The leather is next placed over horses and allowed to drain twenty-four hours. It is then washed and neutralized.

Fully tanned chrome leather can be boiled without curling or becoming hard. If a piece of a skin cut from the neck curls when it is boiled in water the leather is not tanned; if the piece remains soft the leather is tanned. Soft water should be used for making the chrome solution.

One-bath Process with Sulphate of Alumina.—Well tanned leather is secured by tanning the pickled skins in the following process. For every 100 lbs. of skins dissolve by boiling in 5

gallons of water, 4 lbs. of sulphate of alumina; in another tub dissolve in 5 gallons of boiling water, 4 lbs. of sal soda. Pour the soda solution slowly and with constant stirring into the alumina solution, allowing intervals for the effervescence to subside. Set the liquor aside to cool or add cold water to it to bring the temperature down to 80° F. For each 100 lbs. of skins use 10 pounds of salt and 5 gallons of water and drum the skins with this solution ten minutes. Then pour into the drum the alumina-soda liquor and drum the skins forty minutes.

One-bath chrome-liquor (tanolin) is then poured into the drum and the skins are drummed in the combined liquors four or five hours. Six pounds of the tanolin dissolved in 2 gallons of boiling water and poured into the drum in portions of 2 or 3 quarts at a time at intervals of twenty or thirty minutes, will tan 100 lbs. of skins. Finally dissolve and add to the liquor in the drum ½ lb. of salts of tartar and run the drum one-half hour. It is advisable to let the leather remain in the liquor over night, then to run the drum a few minutes the next morning, place the skins over the horses to drain twenty-four hours, and then to wash and neutralize them.

Neutralizing the Leather.—In order that the leather, after it has drained from twelve to twenty-four hours, may be perfectly free from acid when it is to be fat-liquored and colored, it is necessary to wash it in water to which some borax has been added; 1 lb. of borax being generally sufficient for 100 lbs. of leather. First the skins are washed twenty minutes in lukewarm water. The borax dissolved in hot water is then added to the water and the leather is drummed in the solution one-half hour; it is then rinsed well in clear water and thus made perfectly neutral for the dye bath or the fat-liquor. After the skins have been shaved they are dyed black or fat-liquored and then colored with artificial dyestuffs according to the instructions which follow.

Dyeing Chrome-tanned Calfskins Black.

1. *Dyeing with Logwood and Direct Leather Black.*—The use of a direct chrome leather black combined with logwood or some product of logwood is at the present time the most approved method of dyeing chrome calfskins black. A typical formula is: Logwood extract or hematin crystals, 1 lb.; ammonia, 1 oz.; chrome leather black C, 1½ lbs.

The shaved skins are thrown into the drum together with 8 or 10 gallons of hot water. The logwood or hematin liquor, made by dissolving the dye in 2 or 3 gallons of boiling water and made alkaline by the addition of the ammonia, is then poured into the drum and the leather is drummed fifteen minutes. The chrome leather black dissolved in 4 gallons of boiling water is next added to the liquor in the drum through the trunnion, and the leather is drummed fifteen minutes longer.

2. *Dyeing with Logwood, Leather Black and Titanium Salt.*—A rich black is obtained by carrying out the following instructions, the quantities of dyestuffs mentioned being sufficient for 100 lbs. of leather: Drum the leather in a solution of 3 ozs. of titanium-potassium oxalate for ten minutes. Dissolve by boiling in 8 gallons of water, 1½ lbs. of logwood crystals, ½ lb. of chrome leather black and 4 ozs. of sal-soda, and drum the leather in this liquor fifteen minutes. Then pour into the drum another solution of 3 ozs. of the titanium salt and continue the drumming ten minutes longer. The leather is next fat-liquored.

3. *Dyeing with Acid Blacks.*—This method of blacking the leather is to be given the preference if the skins have not been entirely neutralized or if special value is placed upon good penetration. From 1½ to 2 lbs. of Nerazine G or of Neutral Black B (Casella) are required for 100 lbs. of leather. The leather is run a few minutes with 10 gallons of water at 130° F. The dissolved dyestuff is then poured into the drum and the drumming continued twenty minutes. About 1 lb. of formic acid or ½ lb. of sulphuric acid in water is then added and the drum is run ten minutes longer. For filling the

leather a fairly large quantity of logwood extract or gambier may be added to the dye bath. When this method of dyeing is used it is best to fat-liquor before dyeing since the black is apt to bleed when an alkaline fat-liquor is used subsequent to the dyeing.

Acid blacks are also combined with direct blacks in order to get good penetration; in this case the addition of acid is omitted, the leather being entirely neutralized before it is blacked.

Fat-liquoring. — After calfskins have been tanned into leather by a process of chrome tanning, it is necessary to treat them with oil or grease in some form in order that they may be finished into soft, well nourished leather. The quality of the finished product depends largely upon how this process is applied and what materials are used. Nothing that seriously effects the color or makes the leather greasy or spotted can be used. The skins can be fat-liquored either before they are colored or afterwards, the usual custom being to do the work before coloring in order that the fat-liquor will not injure the color. Black leather, however, is usually fat-liquored after it has been blacked. Some tanners, in order to save labor, do not wash their leather after dyeing it; they simply drain off the spent dye liquor and run in the fat-liquor. And in some cases the dye liquor is not even drained off, the fat-liquor being added to it after the leather is colored. The oil and grease are usually employed in the form of an emulsion which is readily taken up by the leather.

The skins are usually shaved before being fat-liquored; but there are tanners who prefer to shave their leather after it is blacked. When this is done only one-half of the dye required for shaved leather is used, and some nigrosine or other stain is added to the fat-liquor to cover up the unevenness produced by shaving.

The preferred method of fat-liquoring the leather is to take it after shaving for colored leather, and after dyeing for black leather, and fat-liquor it as follows: A suitable drum is heated with live steam to 140° F.; the condensed steam is

drained out and the leather is thrown in. The drum is then set in motion and the leather drummed a few minutes to warm it. The hot fat-liquor is then poured through the funnel attached to the gudgeon into the drum and the leather is drummed with it thirty minutes or longer or until it has absorbed the grease. The fat-liquor should be hot, from 120° to 160° F.; and the less water there is in the leather the more quickly the fat-liquor is taken up.

Sulphonated oils are of much value to the tanner of chrome calfskins. Combined with neatsfoot oil and moellon degras the sulphonated oil acts as an emulsifier and carrier of the other oil and grease into the leather where it feeds and nourishes and gives the desired feel to the goods. The following fat-liquors can be used on black or colored leather with perfect safety.

1. Take 6½ lbs. of neatsfoot oil and heat it to about 160° F. Dissolve 2½ lbs. of potash soap in hot water and stir it into the oil and mix thoroughly. When the mixture has cooled slightly add to it 6½ lbs. of sulphonated oil and mix thoroughly. 3 pounds of mixture dissolved in 12 gallons of hot or boiling water will fat-liquor 100 lbs. of leather.

2. A richer fat-liquor that gives a better nourished feel to the leather is made of 12½ lbs. of neatsfoot oil, 2½ ozs. of carbonate of potash, 3¾ lbs. of potash soap, and 4 lbs. of sulphonated oil.

Heat the neatsfoot oil and the carbonate of potash to 160° F. Add the soap dissolved, and stir well. Cool slightly and add the sulphonated oil, stirring the mixture very thoroughly. Use 3 lbs. of it dissolved in twelve gallons of hot water for 100 lbs. of leather.

3. An excellent fat-liquor is made of soap, oil and degras. For 100 lbs. of leather use: Fig or olive oil soap, 1 lb.; neatsfoot oil, 2 lbs.; moellon degras, 2 lbs.; caustic soda, 1 oz. Boil the soap in a few gallons of water until it is dissolved; then add the oil and boil the mixture fifteen minutes. Then stir the moellon degras in thoroughly, adding the caustic soda dissolved in water. Stir the mixture very thoroughly, adding

enough water to make 12 gallons of fat-liquor. Use at 125° F., and run the leather in it one-half hour.

4. This is a good fat-liquor for colored leather. Soap, ½ lb.; olive oil, 2 lbs.; treated cod oil, 2 lbs.; birch oil, 2 ozs.; salts of tartar, 3 ozs.

Boil the soap until it is dissolved; add the olive and cod oils and boil several minutes; then stir in the birch oil and the salts of tartar dissolved in a little water. Add enough water to make 12 gallons of liquor and use it at 125° F.

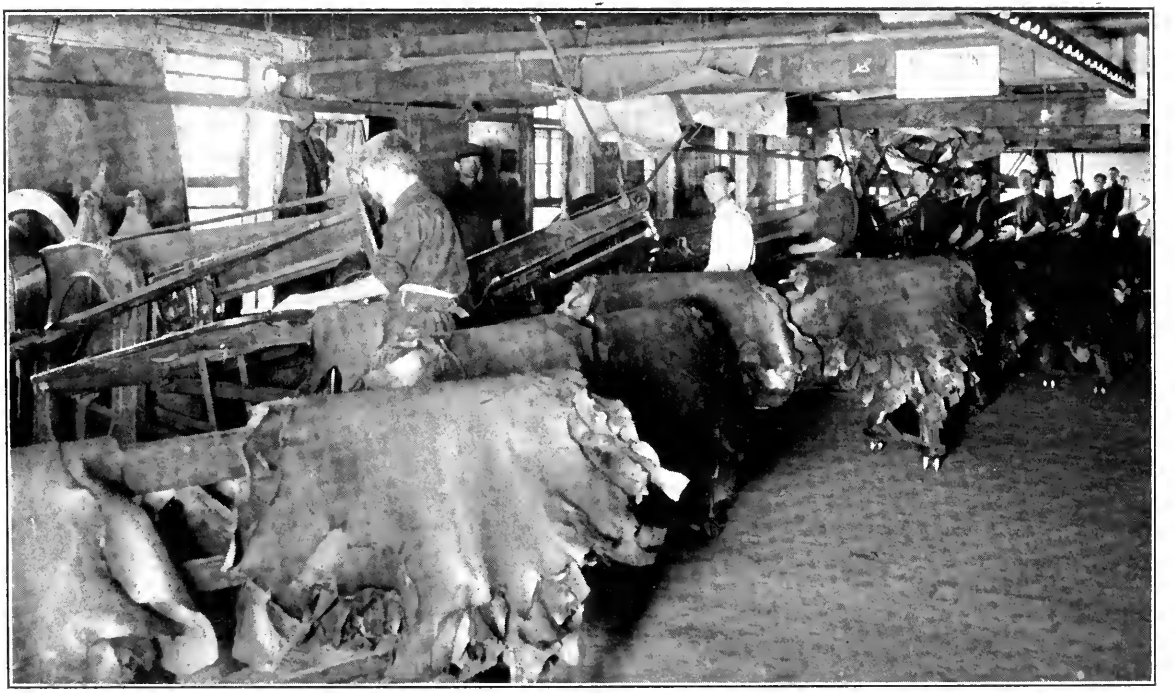
5. Castor oil soap and castor oil make an excellent fat-liquor for colored skins. One-half pound of the soap and ¾ lb. of the oil may be used in 10 to 12 gallons of water for 100 lbs. of leather.

6. In this liquor neatsfoot oil and cod oil are used, 1 pint of each being stirred together with 1 pint of a 10 per cent. solution of soda, and the mixture is stirred into a hot solution of 3 lbs. of soap chips in 6 pints of boiling water; 5 or 6 pounds of the mixture are used for 100 lbs. of the shaved skins.

7. For lightweight colored skins a satisfactory fat-liquor is made of: Castile soap, 1½ lbs.; neatsfoot oil, 1½ pints; eggyolk, ½ lb. For 100 lbs. of leather. Dissolve the soap in a pailful of hot water, then add the oil and eggyolk and mix well. Make up to 12 gallons and use at 125° F.

8. This fat-liquor is particularly suitable for dull-finished leather. Fig or other good soap, 1 lb.; treated cod oil, 4 lbs.; moellon degras, 2 lbs.; caustic soda, 1 oz. Boil the soap; add the oil and boil again; then add the degras and soda and stir five minutes. There should be 12 gallons of the liquor. Use at 125° F., and drum the leather with it one-half hour.

9. A fat-liquor made according to the following formula is suitable for either black or colored leather and is perfectly satisfactory in every respect. Olive oil soap, 1 lb; borax, 1½ ozs.; neatsfoot oil, ¼ lb.; eggyolk, 1½ lbs. For 100 lbs. of leather. Boil the soap in 2 gallons of water. Dissolve the borax in a little hot water and stir it into the neatsfoot oil. Add water to reduce the temperature to 90° F., and stir in the eggyolk. Make up to 12 gallons and apply at a temperature



STAKING CHROME-TANNED CALFSKIN IN AN UPPER LEATHER TANNERY.

To face page 115

of 125° F. The fat-liquor is usually absorbed by the leather in thirty minutes.

Oiling the Leather.—When the fat-liquoring has been accomplished the skins should be placed smoothly over horses to drain several hours; they are next struck out on the grain side and oiled. The water should be pressed out of the leather before the oil is put on so that the latter can quickly penetrate into the body of the skin where it will add strength to the fibers. For this oiling of the grain there is no oil better than neatsfoot oil, which is used alone and also in combination with paraffine oil. For bright finish a mixture of 1 part neatsfoot oil and 3 parts paraffine oil is sometimes used; for dull leather equal parts of the two oils. Olive oil also is recommended for glazed leather. Sperm oil and treated dressing oils are also good for the purpose.

It is advisable to apply the oil hot to the leather and to avoid oiling the flanks. After the skins have been oiled they are hung up to dry. It is best to dry them rather slowly in a moderately warm room with a good circulation of warm air.

The next treatment is dampening and staking, which are usually not done until the leather is perfectly dry.

Dampening and Staking.—The dampening of the dry leather can be done by dipping the skins in hot water and then placing them in piles or in a box, pressing them down well and covering the pile with damp sawdust. Let them remain in the pile or box over night; then stake them. The leather should not be staked too hard, the flanks particularly being gone over very lightly.

The dampening of the leather can also be done in a satisfactory manner with a hose having a nozzle that throws a fine spray. Each skin is sprayed on both sides and the pack is covered up and left until the next morning.

Staking should be done carefully and thoroughly and the leather should be dried after each staking. When the staking has been done, the skins should be tacked out moist on boards to dry, or stretched in frames. They soon dry and should then be trimmed and finished. For glazed finish it is advisable to stake after trimming.

Glazed Finish.—When the leather has a clean, dry grain it is not difficult to get a nice bright finish and only a little seasoning or finishing ink is required. A good bright finish cannot be secured where the grain is greasy, when too much seasoning ink is applied, or when the pressure of the glazing machine is too high. The leather should be clean and dry when the seasoning is applied and should be dried in a warm room and, if possible, glazed while it is warm.

A small quantity of ammonia or of alcohol may be added to the seasoning to overcome oily grain, but either must be used sparingly or it will give a dry feel to the leather and the finish will fly off during glazing. For ordinary glazed finish blood seasoning is satisfactory. Sponging the grain with a dilute solution of formie or lactic acid cuts out surface grease and when the grain has dried the leather is in condition to be seasoned and finished. It is often advisible for the tanner to buy his finishes rather than to make them himself unless he has exceptionally good formulas.

Give the grain an application of seasoning, rubbing it in well. Hang the leather up to dry, then glaze it. Next give a second coat of seasoning, dry and stake the skins; then glaze them the second time.

The leather can be handled this way also. After the first glazing stake the skins; then apply the second coat of seasoning, dry and glaze again. Oil the glazed finish lightly with hot finishing oil or with a mixture of equal parts of neatsfoot and finishing oils as the finishing touch.

Seasoning for Glazed Finish.—Whole flaxseed, 2 ozs.; logwood crystals, 2 ozs.; nigrosine black, 2 ozs.; bichromate of potash, ½ oz.; vinette, ½ pint; beef blood, one quart; glycerine, ½ pint; crystal carbolic acid, 1oz.

Boil the flaxseed one-half hour in a gallon of water and strain. Add the logwood, nigrosine and bichromate of potash. When the mixture has cooled to 90° F., add vinette, blood, glycerine and carbolic acid. Stir the mixture very thoroughly. There should be 2 gallons of it. If there is less than 2 gallons add enough cold water to make it the desired quantity.

Boarded or Box Finish.—The leather for boarded grain should be glazed and the grain pressed. To obtain a sharp and regular grain it is best to press the leather before boarding or graining it. A powerful press and sharp cut rolls are required. Then the skins are boarded first from head to tail, then from side to side. The grain is then oiled the same as smooth finish.

Smooth Dull Finish.—Take the skins from the tacking frames and trim them. Apply a coat of dull dressing to the grain and let it dry; then give another coat and dry again. Finally iron the leather with a hot iron, then stake it. Finished in this way, the leather has a fine break and feel and is soft and full.

Where the grain is bad a light snuffing is necessary to improve its appearance. Some finishers simply apply a coat of the dressing and allow it to dry. A coat of finishing oil is then applied and the leather is ironed.

Seasoning for Dull Finish.—Ivory soap, 1 lb.; neatsfoot oil, 1 pint; whole flaxseed, ½ lb.; beeswax, 3 ozs.; nigrosine black, 3 ozs.; powdered aloes, 1 oz.; wood alcohol, ½ pint. Boil the soap, oil, flaxseed and beeswax one-half hour in 2 gallons of water. Cool and strain. Then dissolve the nigrosine in 1 quart of water and add it to the solution. Dissolve the aloes in the wood alcohol and add to the finish. Stir thoroughly.

Gun Metal Finish.—To get this finish take the skins after trimming and glaze them, then stake them. Next apply a coat of the following finish, after which dry and iron the leather, then oil the grain with hot oil: Gum tragacanth, 1 oz.; yellow dye-stuff, ½ oz.; seasoning for glazed finish, 1 gallon.

Soak the gum tragacanth twenty-four hours in 2 quarts of water; then stir it until it is dissolved. Dissolve the yellow dye in 1 quart of water. Take 1 gallon of the seasoning for glazed finish and stir into it 1 quart of the gum solution. Then add the solution of yellow dye, a little at a time, stirring thoroughly, until the color of the mixture has changed from black to greenish-black. Too much yellow dye must be guarded against or the finish will be too green. For oiling

off after finishing, use a mixture of equal parts of paraffine and neatsfoot oils or any other good finishing oil.

Seasoning for Colored Chrome Calfskins.—After the skins have been trimmed apply a coat of finishing seasoning, dry and finish. Make the seasoning of: Ivory soap, 1½ lbs.; French gelatine, 3 ozs.; blood albumen, 3 ozs.

Shave the soap into 6 quarts of water and boil until it is dissolved. Dissolve the gelatine in 1 quart of hot water. When both solutions have cooled mix and stir them together. Soak the blood albumen over night in 2 quarts of water at 90° F. In the morning stir the soap into it. Strain a quart of the finish into 6 quarts of warm water. Apply a coat of the dressing to the leather; allow it to dry; then stake lightly and give a second application and dry again. When the leather is still somewhat moist, roll it; then dry it and jack it lightly, using a piece of hard felt in place of the glass. The pressure must be light or the leather will show shaded spots.

Bright Finish, Smooth or Boarded, is obtained in this manner: Apply to the staked and trimmed leather a coat of seasoning for glazed finish and when it is dry glaze under moderate pressure. Then apply a coat of finishing oil and iron the leather. A second coat of glaze seasoning is then applied and after it is dry the leather is glazed again. This gives a smooth finish that is popular at the present time. If a box grain is wanted board the skins after the second glazing.

The Coloring of Chrome-tanned Calfskins.—Chrome-tanned calfskins that are to be colored should be selected with care. Only perfectly sound skins that are free from lime spots, scars and other defects should be used. It is essential that the chrome tannage yields a full leather which is soft after it is dried even if but lightly fat-liquored. Before any attempt at coloring is made the leather should be thoroughly neutralized and washed free of acid and salts acquired during the tannage. And after the skins have been washed it is necessary that they be shaved and made smooth and clean upon the flesh-side.

The dyeing itself may be done in several different ways.

Usually a drum is used, and a large number of skins are colored at one time with very little labor.

Acid dyestuffs are applied direct to the chrome leather, some sumac or gambier liquor being added to the dye bath to give fullness to the leather. Basic dyestuffs are applied upon a tannin mordant. The leather is drummed with a solution of sumac or gambier and then in the solution of basic aniline dye. The skins should not be allowed to dry until after they have been dyed and fat-liquored.

Much can be accomplished towards getting the skins in the best condition possible for coloring by using fresh, clean soaks, and, if necessary, some antiseptic added to the same; by liming rapidly and by maintaining a favorable and uniform temperature and by drumming as little as possible before the leather is tanned; by thorough deliming in clean bates or drenches, which do not act too severely upon the tender skins; and by tanning thoroughly so that the leather will dry soft and pliable and free from grease and discoloration. Perfect absorption of the fat-liquor is essential if the leather is fat-liquored before it is colored. This cannot be accomplished unless the skins are completely neutralized.

Coloring with Acid Dyestuffs.—This is one of the most approved methods of coloring chrome-tanned calfskins in use at the present time. The leather, neutralized and shaved, is fat-liquored with a suitable fat-liquor, and is then in condition to be colored. It is put into the drum together with 12 gallons of water at 125° F. for each 100 lbs. of skins in the pack, and the drum is set in motion. The hot solution of dyestuff, containing no acid, is then poured through the hollow axle into the rotating drum and the leather is drummed twenty minutes. In order that there may be good penetration of the color 2 or 3 ozs. of strong ammonia should be added to the dye liquor and the drumming be continued for twenty minutes longer. At the end of the time stated, in order to fix the color upon the leather, there should be added to the liquor in the drum 4 or 5 ozs. of sulphuric acid, or three times as much bisulphate of soda in solution is poured into the drum and the drum-

ming continued ten minutes. Formic acid may be used in place of sulphuric acid, 2 or 3 parts by weight for every 4 parts of dyestuff.

Two gallons of sumac liquor added to the color bath at the beginning or after it has been acidified improves the feel and fullness of the leather. One gallon of gambier liquor is also good for this purpose. The sumac liquor is made by scalding 3 or 4 lbs. of sumac leaves or sumac powder with 2 to 3 gallons of hot water and straining the decoction.

In order that the shades may be the fullest possible the acid colors should be topped with basic colors. This is done by adding the sumac to the dye-bath after the latter has been acidulated, and then to add 2 ozs. or more of basic dye as soon as the color of the acid bath has been exhausted by the addition of acid or bisulphate of soda. If this cannot be done satisfactorily the skins are run in a fresh bath of basic color, in which case no further rinsing is necessary.

When rinsing the acid colored leather it is well to add to the water a solution of 4 ozs. of acetate of soda crystals for 100 lbs. of leather.

Coloring with Basic Dyestuffs.—When basic colors are used the leather is neutralized after tanning, shaved and fat-liquored, and then treated with a solution of vegetable tanning matter, such as sumac or gambier. For 100 lbs. of leather an infusion of from 3 to 6 lbs. of sumac leaves, passed through a strainer or a correspondingly smaller quantity of gambier is sufficient. After the leather has been drummed with the sumac twenty minutes there should be added for each dozen skins 2 or 3 ozs. of tartar emetic dissolved in hot water, and the drum be run fifteen minutes longer. The skins should then be rinsed in clean warm water, put back into the drum and colored with the basic dyes.

For one dozen small skins 2 lbs. of dry powdered sumac may be used, or 4 ozs. of extract of sumac, and 2 ozs. of tartar emetic. This gives a good bottom for the colors. Gambier is used in the following manner:

Gambier and Fustic Mordant.—For each 100 lbs. of leather

to be colored use 2 lbs. of gambier and 1 lb. of extract of fustic. Boil these materials in 4 gallons of water until they are dissolved, then add 8 gallons of water. Drum the skins with this liquor at 125° F. thirty minutes. Then dissolve in a little hot water and pour into the rotating drum 4 ozs. of titanium-potassium oxalate, and run the drum ten minutes longer. This mordant can be used for either acid or basic dyes. If, at the end of the time stated, the skins have taken up the mordant, the liquor should be run off and the solution of dye run in without washing the leather. If the liquor does not seem to be fully exhausted it is advisable to run it off and wash the skins before applying basic dyestuff. For acid dyes washing is unnecessary. Any shade of tan, brown, oxblood, etc., can be obtained on this gambier mordant in a most satisfactory manner. Gambier can also be used alone, 2½ lbs. of it for 100 lbs. of leather. Use the same as the gambier-fustic liquor.

Sumac Mordant.—Use 2 lbs. of dry powdered sumac in water at 125° F. for one dozen skins, or 1 lb. of the extract of sumac. Drum the skins in the liquor twenty minutes. For 100 lbs. of leather in the drum, dissolve and add to the liquor, 4 ozs. of titanium-potassium oxalate and drum ten minutes longer. Then drain the liquor off and run in the solution of color.

Fustic Mordant.—The extract of fustic is also excellent material to use as a mordant, either alone or combined with logwood or gambier. Young fustic and the salt of titanium give a light tan color. Gambier and red fustic alone followed by the titanium salt produce a brownish tan shade. From 5 to 12 ozs. of liquid extract of fustic for each dozen skins, according to their size, may be used for light or dark shades.

For dark shades, such as chocolate brown, it may be used in equal proportions with pure logwood liquor.

The skins are drummed in the liquor at 120° F. twenty minutes. Then a solution of titanium-potassium oxalate is run in and the drum run ten minutes longer. The liquor is then drained off and the dye liquor run in, either basic or

acid, although the fustic mordant is generally used only for basic coloring.

Clearing the Grain and Setting the Color with Tartar Emetic.—When tanning material is used to prepare chrome leather for aniline dyes it is advisable to use some material that will overcome any tannin that is not combined with the leather, to clear the grain and to set the color upon the leather. Tartar emetic is generally used for this purpose. After the skins have been drummed in the tan liquor the required length of time, a solution of tartar emetic is poured into the drum and the skins are run twenty minutes longer; 4 ozs. per dozen skins is sufficient. At the end of the time stated the liquor is run out of the drum, the skins are rinsed and colored.

When the salt of titanium is used it is not necessary to use tartar emetic; and when tartar emetic is used it is not necessary to use bichromate of potash or anything else to set the color. The writer personally prefers the use of titanium-potassium oxalate.

Light Shades of Color, such as grey, beige, champagne, etc., are dyed with acid dyes in the following manner: The leather is drummed with the solution of dye at 130° F. for ten minutes. The fat-liquor is then added and the drum is run one-half hour. Variations of this method are to apply the fat-liquor first and then the dye, or to apply fat-liquor and dye simultaneously. In order to obtain good penetration all that is necessary is to neutralize the leather well and to prolong the drumming process. It may be advantageous to add a little soap to the ordinary fat-liquor.

It is also highly beneficial to the leather to add to the bath after the fat-liquor has been absorbed a decoction of 3 to 6 per cent. sumac or a solution of 3 to 4 per cent. gambier, and to run the drum a half-hour longer. For very pale shades the leather should first be passed through a solution of 1 per cent. oxalic acid, next through a sugar of lead solution, one or two minutes in each case, and then rinsed, and the treatment repeated if necessary, or colored with acid dyestuff as directed above.

Diamine colors are of value to the dyer of chrome leather. No mordant is required, the skins being simply run in the solution of dye. After the leather has taken up the color a solution of bichromate of potash or of sulphate of copper should be added to the liquor for the purpose of setting the dye and making it faster to the effect of the fat-liquor. A little salt added to the dye bath is helpful in getting good shades of color.

Diamine blacks are used successfully with logwood, the leather being first dyed with the diamine black and then with logwood. By using these newer blacks tender and harsh grain is prevented. A good way to use the colors is to dye the leather with them and then to top off with basic dye, which produces colors that are fast, full and rich. Diamine dyes are especially useful for leather that is finished dull or upon the flesh side. Calfskins colored with such dyes should be fat-liquored with acid fat-liquor.

Popular Shades of Color.—1. Dark Tan for 100 lbs. of shaved leather, fat-liquored. Dye thirty minutes with 20 ozs. of chrome fast phosphine B M R; then add 5 lbs. of fustic extract and drum thirty minutes longer. Temperature 120° F. Then add 2 or 3 ozs. of bichromate of potash and let the drumming continue twenty minutes.

2. A dark chocolate brown can be obtained on chrome calfskins by using the following process: For 100 lbs. of leather use 2¼ lbs. fustic extract, lemon shade; 10 ozs. hypernic extract; 3 ozs. logwood crystals. Dissolve all by boiling in a few gallons of water; add enough cold water to make 12 gallons of liquor. Use at 130° F. Drum thirty minutes. Then dissolve and pour into the drum 5 ozs. of titanium-potassium oxalate and run the drum ten minutes longer. The leather should then be washed and fat-liquored, no other coloring being necessary.

3. Chocolate brown can also be obtained in this manner: Drum the leather with gambier or with gambier and fustic extracts thirty minutes; then add the solution of titanium salt and drum ten minutes longer. Chocolate brown basic dye is

then dissolved, from 6 to 12 ozs. per dozen skins, according to their size. Drum the skins in the dye liquor, then wash them, and if not previously fat-liquored apply acid fat-liquor; if fat-liquored before dyeing, wash them and dry them for finishing.

4. Another excellent shade of brown can be obtained by carrying out the following instructions: For each dozen skins use 10 ozs. of liquid extract of sumac or fustic dissolved in hot water. Drum the leather with this liquor fifteen minutes; then pour into the drum 4 ozs. of tartar emetic and continue the drumming fifteen minutes, after which rinse the skins in warm water and dye them with these dyes: Phosphine for leather, 8 ozs.; leather green, ½ oz.; methyl violet, 2 B, 1 oz. The anilines must be thoroughly dissolved and mixed before use. Titanium salt may be substituted for tartar emetic. The skins, fat-liquored before coloring, are washed, struck out and dried.

5. For light tan shade, use 2 lbs. of yellow fustic extract and 4 ozs. of titanium-potassium oxalate for 100 lbs. of leather. Have 12 gallons of fustic liquor at 130° F., and drum the skins in it one-half hour. Then pour into the drum the titanium salt dissolved in hot water and run the drum fifteen minutes. The skins should then be washed and fat-liquored. Leather dyed in this manner has a pleasing shade of tan without further coloring. However, if the color is not satisfactory basic dyestuffs can be applied to get the shade that is desired.

6. A dark tan is obtained by using 4 lbs. of fustic extract and 6 ozs. of the salt of titanium in the same manner as No. 5.

7. Alizarine brown without a tannin mordant is used in this manner: For each 100 lbs. of skins use alizarine leather brown B No. 9052, 12 ozs., and extract of yellow fustic, 1 quart. Use the dye in 12 gallons of water at 165° F., and drum the leather one-half hour. In the meantime dissolve the extract of fustic in 1 gallon of hot water, run it into the drum and drum the skins fifteen minutes. Then drain off the spent dye liquor and give the skins the fat-liquor.

8. The following formula for dark tan is used and approved by the Tannery School of Pratt Institute, Brooklyn, N. Y. The quantities of dyestuffs mentioned are for 100 lbs. of leather. The skins are run for one-half hour in the drum with three pounds of powdered fustic in twenty gallons of water at 125° F. A solution of 4 ozs. of titanium-potassium oxalate in 2 gallons of hot water is then added to the contents of the drum and the leather is run fifteen minutes longer. The skins are then washed for five minutes with warm water. The color solution is prepared with Flavo-Phosphine G G Conc. 22 ozs.; Vesuvine R, 3 ozs.; Methylene Blue B, $\frac{1}{8}$ oz.; water of 140° F., 40 gallons; 10 gallons of water at 150° F. are added to the leather in the drum. The door is closed and the drum set in motion. One-third of the color solution is strained and poured in through the trunnion; at the end of five minutes a second portion of the strained solution is introduced, and after three minutes the last portion is added. The leather is now run one-half hour, the liquor drained off and the fat-liquor is poured in through the trunnion.

9. *Dark Oxblood Shade.*—For one dozen small calfskins use as a mordant peachwood extract, 2 lbs.; fustic extract, 1 lb. Dissolve these extracts in boiling water and use at 110° F. Drum the skins one-half hour. Then add the solution of titanium salt and drum ten minutes longer. Dissolve by boiling the following anilines: Amaranth 3-R, 6 ozs.; malachite green, $\frac{1}{8}$ oz. When the ten minutes are up, drain the liquor out of the drum and run in the dye, using 3 gallons of water for each dozen skins.

10. For this shade of oxblood prepare the skins with gambier and fustic and titanium-potassium oxalate; then apply the following dyes: Amaranth 3-R, 2 lbs.; amaranth 1-R, 12 ozs.; chocolate brown, 4 ozs. These quantities are for five dozen small skins. Divide the amaranth 3-R into four portions and drum the skins ten minutes after each portion is put into the drum. Next add the other two dyes and drum one-half hour; then drain and fat-liquor the leather.

11. This formula produces a nice shade of oxblood at less

expense than aniline colors and the color is rich and fast. For 100 lbs. of leather use: Hypernic extract, 2¼ lbs.; logwood crystals, 1½ ozs.; leather red, ½ oz. Use in 12 gallons of solution at 130° F., and drum one-half hour. Then pour into the drum a solution of 4½ ozs. of titanium-potassium oxalate and drum fifteen minutes longer. Wash and fat-liquor the leather, or simply drain off the dye liquor and run in the fat-liquor.

12. A good shade of oxblood can be secured by using peachwood extract and fustic extract as a mordant for basic aniline dye. For one dozen large skins use 2½ lbs. of peachwood extract and 1 lb. of fustic extract, dissolved by boiling and used at 110° F. Drum one-half hour. In the meantime dissolve by boiling in a clean pail 12 ozs. of amaranth 3 R and 8 ozs. of glycerine. Strain the solution, add 3 gallons of water and apply to the skins at 110° F. Drum the skins one-half hour. Then dip each skin separately into clean water, and wash out the drum. Put the skins back into the drum and run them in a solution of 2 ozs. of bichromate of potash per dozen for fifteen minutes.

A greater richness of color can be obtained by increasing the strength of the peachwood and fustic liquor. For a light shade use more fustic and less peachwood extract. Fat-liquoring may be done before or after coloring.

Quermos extract is an excellent mordant for colors, 2 to 3 lbs. in 12 gallons of water being sufficient for 100 lbs. of leather. Use the same as gambier and sumac.

Chrome-tanned Wax Calf Leather.

The tanner of chrome calfskins finds among his skins many that have defective grain. Such skins can be retanned and finished into chrome wax leather. Heavy skins are more suitable for this leather than light ones, the light stock being more suitable for ooze leather. All skins from a medium up to 10 to 12 lbs. can be worked into chrome wax, provided they are free from butcher cuts on the flesh side. They are worked through the preparatory process in the same manner as those

for chrome leather, they being tanned with one-bath chrome liquor and shaved. After they have been shaved, they are washed and tanned.

Retanning.—This consists in retanning the skins with hemlock extract or with a mixture of hemlock and oak extracts, hemlock and quebracho extracts, or with other suitable tanning material. Two methods of retanning will be described.

The first liquor is a 5-degree barkometer hemlock liquor in which the skins are hung twenty-four hours. This liquor is then strengthened to 8 degrees, and the skins are left in the same forty-eight hours, after which the strength is increased to 10 degrees, the skins remaining therein forty-eight hours. The next liquor is a 14-degree one. The skins are transferred to this liquor and remain in it six days. Handle them every two days or give them a 16-degree liquor for four days, and handle every two days; then they should be given five days in an 18-degree liquor, being handled every other day. The retanning is now complete. The liquors may also be made up of oak and hemlock extracts in the proportion of 3 parts of the latter to 1 part of the former.

Retanning may also be done in a drum in the following manner: The first liquor is made of 3 lbs. of hemlock extract and 1 lb. of oak extract and 5 lbs. of salt in 25 gallons of water for 100 lbs. of chrome leather. In this liquor the skins are run one hour, then they are piled down for twenty-four hours. The second liquor may be the same as the first, the skins being run in it one hour, then piled down for twenty-four hours. On the third day the skins are given the last retanning liquor, which is made up of 3 lbs. of oak extract and 1 lb. of hemlock extract and no salt. The skins are run in this liquor two hours, then placed in piles for twelve hours. Retanning by hanging the goods in the liquor is doubtless the better method of the two. After the leather is fully retanned it should lie on a pile forty-eight hours and then be fat-liquored.

Fat-liquoring.—The fat-liquor is made of soap and degras. For every dozen skins in the lot, 8 ozs. of soap are boiled in

10 gallons of water; when it is dissolved 4 lbs. of moellon degras are stirred in. This liquor is given to the leather at 125° F.; the leather is run in it forty minutes, then left in a pile over night. The next day it is pressed and dried slightly for the second fat-liquoring, which consists of stearine, hard grease and cod oil.

The workman must use his judgment in determining whether the skins are in suitable condition for stuffing. The necks and flanks should be dampened more than the other portions so that they will not absorb too much grease and be made coarse. Chrome wax will not carry as much grease as bark-tanned leather. The stuffing should be used at 140° F. After the skins are taken from the drum they should be placed in a pile and left until the next day. They are then set out on the flesh side with a slicker, and next with a stone, and hung up by the hind shanks until partly dry; they are then reset on the grain side.

When the skins are dry, they are piled down a few days and are then whitened, preferably by hand. After the leather is whitened it is grained with a heavy cork board, going from right back shank to left front shank and vice versa. It should be thoroughly softened before it is blacked.

Blacking.—A good black is made as follows: Take 8 gallons of water and dissolve in it by boiling 1½ lbs. of logwood crystals, then add ½ oz. of bichromate of potash and stir well. Next add 5 lbs. of good tallow soap and ½ lb. of caustic potash and boil for two hours, then add 5 lbs. of good gas lampblack, and boil another hour. There should be 20 gallons when finished. This soap black should be stirred fifteen minutes every three hours until it is entirely cold, when it is ready to be used. The blacking can be put on by machine, and better results are obtained by giving the skins one coat and glossing them; then give another coat and gloss again. After the second glossing the skins are ready for the paste.

Paste.—Mix 2½ lbs. of flour with water until it forms a thin batter. Add to the batter ½ lb. of soap cut into small pieces and ¼ lb. of frozen glue that has been soaked over night in 1

quart of cold water, 2 ozs. of black nigrosine and 1 pint of of cod oil. Boil this mixture half an hour and allow it to cool over night. In the morning add sufficient water to make it thin enough to feed through the machine. Give the skins a light coat of this paste and hang them up until almost dry; then take them down and gloss on the glossing jack and hang up over night, as it is very important that the paste be perfectly dry before the finish is put on.

Finish.—The finish is made as follows: Soak 1 lb. of frozen glue in 3 quarts of cold water twenty-four hours; then add to the glue ½ lb. of Ivory soap, 2 ozs. of beeswax cut into small pieces, 1½ lbs. of white tallow, 4 ozs. of black nigrosine, and boil the mixture twenty minutes and allow it to stand twenty-four hours undisturbed. Now add very carefully 14 quarts of cold water, adding it slowly and stirring all the time. When all the water is mixed in, the finish is ready for use. This finish gives the leather a fine, mellow feel. It should be put on by hand, using a sponge. The leather should be given a good coat and hung up to dry. When thoroughly dry it is trimmed and measured. The finished leather is very fine and soft.

Calfskin Glove and Mitten Leathers.

Glove leather of very durable quality is made by tanning calfskins in a process of chrome tanning. The skins that are most profitable for this purpose are those that are large and thin. During the processes of liming, bating and pickling prior to tanning, the skins are handled in the same manner as skins for shoe leather, except that it is advisable to lime them somewhat more thoroughly so that the leather will be soft and durable.

Tanning is done with the two-bath process or the one-bath process in the manner that has been already described. Another excellent way to tan the goods is to first give them an alum tannage, dry them out and then retan them with one-bath chrome liquor. This may be done in the following manner: Boil in 5 gallons of water 6 lbs. of sulphate of alumina.

In a pail dissolve in 1 gallon of water 12 ozs. of bicarbonate of soda. Pour the soda solution very slowly and with constant stirring into the solution of alumina. Use the liquor at 80° F.

Put the pickled skins into the drum together with 10 gallons of water, 1 lb. of Glauber's salt and 3 lbs. of common salt for 100 lbs. of skins. Drum the skins in the solution twenty minutes, then drain off the liquor. Put into the drum 10 gallons of lukewarm water and 4 lbs. of salt and run the drum ten minutes. Then pour into the drum the alumina and soda solution and drum the skins with it from two to three hours. At the end of the time stated, take the skins out, drain them over a horse until the next day, then hang them up to dry.

When dry put the skins back into the drum together with 12 gallons of water and drum them fifteen minutes. Drain the water off and retan the leather with 8 lbs. of chrome alum dissolved in 10 gallons of water for 100 lbs. of wet leather. Drum an hour and a half. Then add gradually to the liquor 1¼ lbs. of soda ash or 3 lbs. of soda crystals in solution diluted with ½ lb. of formaldehyde and continue drumming the leather two hours. Take the skins out of the drum and let them drain over horses until the next day. Neutralizing with borax is then done in the usual manner. The leather is then washed in running water, and later fat-liquored with any good chrome leather fat-liquor, or the following, which is especially suitable for glove leather: Olive oil soap, 1¼ lbs.; borax 2 ozs.; neatsfoot oil 1 lb.; egg-yolk 2 lbs., for 100 lbs. of wet leather. Apply the liquor at 125° F. and drum the leather with it thirty minutes. The leather may then be dyed in various ways. By applying anthracene chromate yellows and browns at a temperature of 170° F., colors of unusual fastness are obtained. These dyes may be combined with one another at the will of the dyer to get any shade that may be desired.

A light yellow color is secured without the use of artificial dyestuffs by using gambier, picric acid and fustic extract. Make a gambier liquor by boiling 12 lbs. of gambier in 22

gallons of water. When the gambier is dissolved add to the solution ½ pint of muriate of tin and 1½ ozs. of tin crystals. When this liquor has cooled down to 90° F. it is ready for use.

For from 100 to 150 skins, according to size, use 4 pailfuls of this gambier liquor and 2 or 3 gallons of water. Drum the leather with this mixture one hour. Then add ½ lb. of picric acid and ½ lb. of fustic extract dissolved in 3 gallons of hot water, and let the drum run thirty minutes longer. Then place the skins over horses and let them drain until the next morning. Do not wash one-bath tanned skins, which is the process preferable for this leather, but dry them out and after they are dry wash them for two hours, then dry, stake and finish them. The leather is soft and full; the color is uniform and permanent.

After the skins have been staked, throw them into a drum together with 4 quarts of soapstone for 100 skins, and drum two hours. Finally stake the leather again and it is finished.

A nice yellow shade can also be obtained by the use of fustic and auramine II. For 100 lbs. of leather dissolve 26 ozs. of extract of fustic in 5 gallons of water; add to this solution 5 ozs. of tin crystals and when dissolved, add enough water to make 10 gallons of liquor. Drum the skins in this yellow liquor one-half hour. In 4 gallons of boiling water dissolve 6 ozs. of the auramine dye and run the solution onto the leather on the fustic bottom, and let the drum rotate twenty minutes longer; drain the leather and if it was not fat-liquored before it was colored, fat-liquor it and dry it out for finishing.

A light shade of tan is obtained by using yellow fustic extract and titanium-potassium oxalate. Weigh the shaved skins. Dissolve 2 lbs. of the fustic extract in a pailful of hot water. Put the skins into the drum together with 12 gallons of water at 130° F., for 100 lbs. of leather. Drum one-half hour. Then pour into the drum 4 ozs. of the titanium salt dissolved in hot water. Run the drum fifteen minutes longer; then wash the skins and fat-liquor them.

For a dark shade of tan use 4 ozs. of red fustic extract and 6 ozs. of the titanium salt; otherwise the process of coloring is the same as for light tan.

White Calfskin Leather.

Tanning with Sulphate of Alumina.—Soft, tough white leather is made by tanning calfskins by the following process: The skins are limed, bated and pickled with sulphuric acid and salt in the usual manner and are then allowed to drain twenty-four hours.

To prepare the tanning liquor boil in 10 gallons of water 12 lbs. of sulphate of alumina. In a pail dissolve 24 ozs. of bicarbonate of soda. Pour the soda solution slowly and with constant stirring into the solution of sulphate of alumina. Allow the resultant white liquor to cool to 80° F. Put the pickled skins into a drum together with ten gallons of water, 1 lb. of Glauber's salt and 3 lbs. of common salt for 100 lbs. of skins. Drum the skins with the solution twenty minutes, then drain off the liquor. Put into the drum 10 gallons of lukewarm water and 6 lbs. of salt together with the skins and let the drum rotate ten minutes. Then pour into the drum half of the alumina-soda solution and drum the skins three hours. At the expiration of the three hours, take the leather out and let it drain until the next day; then hang it up to dry.

When dry put the skins back into the drum together with 8 gallons of water and drum them ten minutes, then add the rest of the white liquor and run the drum two or three hours. Place the leather over horses to drain at least twelve hours, then hang up to dry.

Fat-liquoring.—When dry let the leather lay in the crust state in a clean dry room for some time, the longer the better; then dampen it with warm water preparatory to fat-liquoring. Sulphonated castor oil or acid fat-liquor is the material to use as it imparts softness without discoloring the leather or making it greasy. For each 100 lbs. of dry leather use 7 lbs. of the oil and stir it into 10 gallons of water at 95° F. until it is dissolved. Put the moistened leather into the drum; start the drum, and pour the solution of oil through the gudgeon, and drum the leather forty minutes; then let it drain over night. The next day strike out the grain and apply to it a

mixture of French chalk, two parts of glycerine and 4 parts water. Apply this to the grain and then hang the leather up to dry.

Finishing.—Finishing consists of moistening the leather, staking, and tacking it on boards. When dry and taken from the boards, if it is not soft enough, restake it; if staking does not soften the leather sufficiently, wet it and give it more fat-liquor. The appearance of the flesh can be improved by buffing on a carborundum wheel; and the leather can be finished upon the flesh if such flesh-finished leather is wanted.

Another process of making white calfskins is an alum tannage composed of sulphate of alumina, salt, flour, eggyolk and oil. Proportions given are based on 100 lbs. of pickled skins. Make a paste of 5 lbs. of flour and a little water. Dissolve 3 lbs. of sulphate of alumina and 5 lbs. of salt in 10 gallons of water. Slowly add to this 4 ozs. of bicarbonate of soda, and then mix in 2 lbs. of eggyolk and 2 lbs. of olive oil. Add the flour paste and drum the skins with the mixture three hours. Leave in the liquor over night; drum a few minutes the next morning; dry at a moderate temperature.

Finishing consists of staking and buffing the skins, drumming them with 1 lb. of eggyolk and 5 lbs. of French chalk; then setting out, tacking and drying. If colored leather is wanted, the grain can be colored by hand, leaving the flesh white, or a drum can be used and the leather dyed throughout. This class of leather is as a rule dyed with wood colors, which may be shaded with acid colors. Another method is to bottom the leather with wood colors and then to top with basic colors.

Formaldehyde Tannage.—By a method of tanning with formaldehyde white skins are obtained which are very similar to alum-tanned goods. The beamhouse processes are carried out as usual; the skins are next washed in tepid water when they are ready for the tannage. For this a solution of $2\frac{1}{2}$ parts of commercial formaldehyde in 100 parts of water is used. This liquor is prepared in a paddle and the skins are put into it and left in from twenty-four to forty-eight hours,

then withdrawn, neutralized, washed, and fat-liquored with a liquor made of 100 parts of neatsfoot oil, 25 parts of carbonate of soda and 500 parts of water. The skins are drummed in this one hour, then dried and finished. Sulphonated oil can be used for fat-liquoring with good results. And a fat-liquoring with moellon degras gives skins of a light yellow color.

Chrome-tanned Ooze Calfskins.

The skins that are worked into ooze leather must be free from butcher cuts and have full flanks, but good grain is not essential. In almost every pack of skins there are some that have defective grain that are unsuitable for grain finish and can be finished only upon the flesh side. Such skins can be sorted out after the pack has been tanned, or they can be selected after they have been unhaired, and tanned separately from the rest. Skins limed according to the following directions make fine ooze leather: Use 8 lbs. of lime and 2½ lbs. of sulphide of soda for 100 lbs. of skins, weighed before soaking. It is best to give the goods a six-days liming.

Start the liming process by using 2 lbs. of lime; leave the skins in this liquor twenty-four hours. Then pull them out and add 1½ lbs. of lime and 1 lb. of sulphide of soda, and put the skins back. On the third day, haul the skins out; plunge thoroughly and put the skins into the liquor. On the fourth day add 1½ lbs. of lime and the same quantity of sulphide of soda and put the skins back. On the fifth day add 1½ lbs. of lime and warm the liquor again to 70° F., and put the skins back. On the sixth day warm the liquor again to 70° F.; and on the seventh day put the skins into clean, warm water at 85° F., and unhair at the end of one or two hours. Then work the skins over the beam and work out as much of the lime as possible.

Bate with oropon bate, using 8 ozs. for 100 lbs. of skins, in a bath warmed to 95° F. The goods are paddled one hour, then left in the liquor over night and washed and pickled the next morning.

Pickle with a liquor made by adding to 40 gallons of water

40 lbs. of salt and 5 lbs. of sulphuric acid, using 12 gallons and drumming twenty minutes.

The tanning is done most expeditiously with tanolin. Weigh the pickled skins and throw them into the drum together with 10 gallons of water in which 6 lbs. of salt have been dissolved for 100 lbs. of skins, and drum fifteen minutes. Dissolve in 2 gallons of boiling water 6 lbs. of tanolin, using the solution when it is cool. Divide it into three portions. Pour one portion into the drum and drum thirty minutes. Then add another portion and run the drum another half hour. Then pour in the last portion and let the drum run one hour. Dissolve in a little hot water 8 ozs. of bicarbonate of soda, pour the solution into the drum and continue the drumming two hours. Then pour in 6 ozs. more of soda and run an hour longer or until the skins are thoroughly tanned. Horse the leather up forty-eight hours before neutralizing and washing it. It is then washed in a drum with 10 gallons of water to which ½ lb. of bicarbonate of soda has been added, for one-half hour, and then next wash with running water for one-half hour. The skins are then set out and shaved.

One method of finishing the skins into ooze leather is as follows: The skins are fat-liquored with a suitable fat-liquor and to the same some substance is added which, during the subsequent drying, isolates the fibers of the leather in such a manner as to allow them to be soaked and softened without difficulty. For this purpose dextrine, grape sugar, syrup, etc., are used. The stuffed leather is dried and then buffed. Buffing is done either by running the flesh-side on an emery wheel or by slightly grinding the grain. The ground leather is then drummed with warm water until it has regained its original softness, and is then colored with acid dyestuffs. During or after the dyeing, a somewhat larger quantity of gambier or sumac is added than is otherwise customary with chrome leather, in order to impart to the leather the necessary firmness. The nap of the skins is then raised by working the leather in a dry drum after it has absorbed some moisture by a treatment with wet sawdust. The coloring is done in the same manner as has been described for grain leather.

Another way to produce ooze leather is as follows: After shaving, the skins are run together with pumice in a clean drum. For 100 lbs. of skins use 1 quart of pumice and drum with it thirty minutes; then cut the flesh-side on a wet wheel so that the fibers are uniformly fine over the entire skin. After this has been done wash the leather thoroughly to remove all the pumice. The skins are then in condition to be colored and fat-liquored, these processes being the same as for grain-finished leather.

If black leather is wanted, drum the skins in a solution of Bismarck yellow brown or some other direct yellow brown, then drum with a logwood liquor that is slightly alkaline, and strike with acetate of iron or copperas, and fat-liquor them, following this with direct leather black, fat-liquoring again, and then hanging the skins up to dry.

There are special ooze blacks upon the market that produce good results. They dye direct without the use of mordant or logwood.

For light skins a fat-liquor of eggyolk and sperm oil is suitable; and for both light and heavy skins a fat-liquor made of olive oil soap, neatsfoot oil and moellon degras is recommended. It is made as follows: 1 lb. of the soap is dissolved in 6 gallons of boiling water. To the solution are added 4 lbs. of the oil and 2 lbs. of degras and the whole is boiled for thirty minutes. Next add water to make 20 gallons of liquor. In a separate vessel dissolve 6 ozs. of carbonate of potash, add this to the fat-liquor, and stir thoroughly. This quantity of fat-liquor is for 200 lbs. of leather. Use it at 140° F. Drum the leather with it forty minutes and then let it drain until the next day. Strike out each skin; oil the grain lightly and hang up to dry.

When dry, dampen and stake the skins, and before they are dry put them into a dry wheel and run them three hours, then tack them out. When dry, stake them lightly and run the flesh side on a plush wheel, which is the finishing touch. Softness, freedom from spots, and smooth, uniform colors and fibres are the essential qualities of this leather.

Velvet or suede leather is finished from chrome calfskins in the following manner: The skins are taken in a dry or crust condition and are dampened with clean, damp sawdust in the customary manner. They are next fluffed on the flesh side, care being taken to avoid scratches, with new or coarse carborundum or emery. The grain then receives a thorough grounding on the buffing wheel, after the leather is perched or staked lightly. After grounding, the skins are given a coat of a solution of dextrine, potato starch or Irish moss, and are then allowed to lay until the moisture has almost evaporated from them, but not entirely, as sufficient moisture should be left in the goods to keep them cool for the wheeling or fluffing on the grain, which follows immediately.

The next process is coloring; and for this a good drumming in warm water to soften the leather is necessary. Add to 12 gallons of water 8 ozs. of borax and drum the skins twenty minutes; then rinse them for a few minutes.

A treatment with sumac is necessary to impart firmness to the leather, 3 or 4 lbs. of sumac extract in water at 125° F. being used for 100 lbs. of leather, which is drummed one-half hour. A solution of gambier is also suitable for the purpose. Drain the liquor out of the drum and proceed to color the leather with acid dyes. Prepare the dye bath by dissolving the amount of color necessary in 15 gallons of hot water, pour this solution into the drum while it is rotating, and drum the skins ten minutes. Then add to the bath 4 or 5 ozs. of fustic extract in solution, and let the drum run twenty minutes longer. Then acidulate the dye bath by adding to it 3 or 4 ozs. of sulphuric acid or three times as much bisulphate of soda in 1 gallon of water, and let the drum run fifteen minutes longer. The dyed leather is next rinsed well in lukewarm water, and next given a drumming with a solution of eggyolk for ten minutes; it is then rinsed, struck out and dried.

Complete penetration of the dye is secured by adding 2 ozs. of strong ammonia to the dye bath and prolonging the drumming to forty minutes or even longer; the ammonia is then

neutralized by using slightly more acid or soda than the quantity mentioned above.

The finishing operations consist of dampening the dry skins and staking them, then buffing on the buffing machine and fluffing lightly on the flesh side. In place of buffing they can be worked over with a warm knife and finished off by working over the grain with very fine emery made up into a suitable pad. This last method gives a beautiful, even, velvety feel and fine appearance to the leather. The last touch is a brushing with a stiff brush.

The Manufacture of Vegetable-tanned Calfskin Leather.

Quebracho Tannage.—Calf skins for upper and fancy leather are tanned in numerous ways. Quebracho extract in solid or liquid form is in common use and produces soft tough leather.

A practical way to tan calfskins with quebracho extract is carried out as follows: A quantity of the extract is dissolved in boiling water. Solid extract should be dissolved in a tub containing a false screen bottom which prevents the extract adhering to a solid surface. Liquid extract should be dissolved in water at 180° F. The solution of extract should be stirred well and allowed to cool down gradually before use. It is a mistake to suddenly chill the extract solution by running it into cold liquor. The tannage should be started in a weak liquor. Having the liquor too strong and thereby drawing the grain must be guarded against during the entire process. The suspension method, by which the skins are not violently agitated, produces the plumpest and best tanned leather, especially along the sides and in the flanks. The skins are tacked with galvanized iron or copper nails onto wooden strips and hung in the liquor.

The first liquor in which the tanning begins, is usually quite weak. Its strength should not exceed 10° barkometer. Where pickled skins are being tanned salt should be added to the tan liquor to prevent the acid in the skins doing injury.

As the tanning proceeds the strength of the liquor is increased until it reaches 20° to 25° barkometer towards the end of the process. The length of time required to accomplish the tanning of the skins depends upon their thickness and the strength of the liquor. It is always advisable to tan slowly so as to get a fine, smooth grain. When the tanning is completed, the leather is washed, pressed and fat-liquored. From seven to fourteen days is the time usually required to tan the skins.

Another method of tanning consists of a liquor made of quebracho extract, alum and salt for the first part of the process, and a clear quebracho liquor for the second part. Prepare a liquor by adding enough dissolved extract to water in a paddle to make a 40 or 50 barkometer liquor and add to the same 1 lb. of alum and 3 lbs. of salt dissolved in hot water for every 100 gallons of liquor. Plunge the liquor well and throw the skins in. Start the wheel and turn the skins in the liquor for thirty-six hours or longer, which strikes them a light oak color; then place them in the second liquor. This should consist of clear quebracho liquor. Add enough dissolved extract to the water in the paddle to make a 6° barkometer liquor. Turn the skins thirty-six hours; then strengthen the liquor to 10° barkometer and continue the turning for two days, or as long as is necessary to complete the tanning. A mixture of quebracho extract and hemlock extract may be used in the same manner, also a mixture of hemlock and oak extract.

When thoroughly tanned the skins are horsed up and allowed to drain several hours or over night, and are then placed in sumac liquor. This is prepared by adding water heated to 122° F. to about 25 lbs. of sumac, using the liquor at 90° F. The skins are thrown in and stirred about, more or less, and left in over night, then drained, set out and either fat-liquored and dried, or dried without fat-liquoring.

Gambier Tannage.—Calfskins can be made into fine, soft leather by tanning with gambier. The skins, having been limed and drenched, are put into a gambier and sumac liquor

of about 10° barkometer. The liquor should be slightly acid to prevent thin leather, acetic acid being used to acidify it. After the skins have been in this liquor from six to ten hours they are placed in another liquor in a paddle, made up with gambier to a strength of 20° barkometer, 1 quart of acetic acid being added for each five dozen skins. In this liquor the skins remain ten hours.

The third liquor should be made to a strength of 35° barkometer and the same quantity of acid added as before. It is also beneficial to the quality of the leather to add to the liquor, after the skins have been in it an hour, a pailful of oak wood extract.

When the tannage is completed, the leather is put into a sumac liquor for several hours or over night, then drained, set out and either fat-liquored and dried without being first fat-liquored. The sumac gives a good bottom for the subsequent dyeing.

A gambier process different from the foregoing method is applied in the following manner: The skins, bated and washed, are run in an old 12° barkometer liquor until they are colored; and are then put into fresh gambier liquor, being hung therein for twelve days, during which time the liquor is gradually strengthened every day. The skins are then pressed and shaved, or split as they may require. They are next run in a 12° barkometer liquor for a day or two before they are placed in a 34° barkometer fresh gambier liquor sixteen days more. Salt should be added to the liquors to aid the tanning and to keep the liquors from getting sour. Light skins, of course, require less tanning than heavy ones, the process as described being suitable for heavy kangaroo skins and calfskins.

The tanned leather is washed, set out on a machine, oiled or fat-liquored and dried at a moderate temperature. When dry, the leather improves in texture by being kept in the crust sometime before it is finished. It can also be passed through a sumac liquor after the gambier tannage is completed. A drumming in a solution of alum and salt clears the grain.

A very satisfactory method of tanning is by the use of vats

or tubs with paddles. In the first vat the skins are colored and handled. In the second liquor they are tanned until they are ready to be skived or split; in the third liquor they are tanned out after skiving. At the start the liquor should be 4° or 5° barkometer and gradually strengthened as the tanning proceeds until the skins are fully tanned. Into the water in the vats should be put 6 or 7 pailfuls of gambier liquor standing at 75° Bé. in the pails or stock solution, also 4 or 5 pailfuls of sediment gambier after the boiling. When the liquor is ready, put the skins in and run the paddle thirty or forty minutes to insure good color on the grain. The liquor should be strengthened twice daily morning and evening, with 2 or 3 pailfuls of gambier and sediment, and the paddle be run three times daily, ten or fifteen minutes each time. At the end of four or five days, the skins should be taken out of the liquor and struck out on the flesh and then put into the second or stronger liquor. By running the paddle three times each day and by adding three pailfuls of 75° Bé gambier liquor each day, the skins become well struck through in about fourteen days. Then set them out on the flesh side, skive them and put them into the finishing liquors of 12° to 15° barkometer for seven days. Each day the liquor should be strengthened with 2 pailfuls of gambier and the wheel be run fifteen minutes each time; one pailful of salt should be added to the liquor each week. The final tanning can also be done in a drum.

After the leather is fully tanned it should be cleared by drumming with alum and salt, oiled and dried. It is then dampened, run in warm water and shaved, after which it is fat-liquored, set out, dried again, dampened and colored.

Another way to treat the skins is to wash them after tanning, then fat-liquor and dry them, shave, and mill them in sumac, and then color them. Good leather is also made by giving a light fat-liquor after tanning and washing; next drying the skins, coloring them and then giving them the second application of fat-liquor.

Dongola Tannage.—Gambier, alum and salt make what is

known as dongola leather. There are many modifications of this process. Fine leather is made by tanning the skins first in gambier or quebracho liquor and then giving them an alum and salt retannage. For 200 average skins a mixture is prepared of 5 lbs. of alum, 9 lbs. of salt, 24 lbs. of flour, 10 dozen eggyolks or a corresponding quantity of sulphonated oil, and 8 to 10 gallons of water. The flour is made into paste with cold water. The alum and salt are dissolved in part of the water and the flour paste is slowly stirred into the solution. The oil or the eggyolk mixed with warm water is next added and the whole mixture stirred thoroughly. The tanned skins are drummed with this mixture one hour, then dried, colored and finished, thus making soft, durable leather.

The above described mixture may also be used upon untanned skins as they come from the bate or drench. They should be drummed with it, dried, kept in crust some time, then wet back and tanned with chrome liquor, the result being soft, durable leather.

The combination tannage of gambier, alum and salt can also be applied in the following manner: The bated and washed skins are placed in gambier liquor in a paddle. From 3 to 5 lbs. of gambier are used for one dozen skins. After they have begun to absorb the gambier, from 8 ozs. to 1 lb. of alum and ½ lb. of salt for each dozen skins are added to the liquor and the paddling is continued until the tannage is completed, which takes from eighteen to thirty-six hours. The leather is then washed in warm water to remove the adhering tan, next fat-liquored with acid fat-liquor, dried, wet back, colored with aniline dyes, or dyed black, dried again, and finished. After the alum and salt have been added it is practicable to put the skins together with the tanning liquor into a drum and drum them a few hours or until they are thoroughly tanned. Some soluble oil may also be added to the liquor and applied to the leather toward the end of the tanning process. Excellent leather is also made by taking the skins out of the gambier liquor when they are well struck through, striking them out and then drumming them with a paste of

water, flour, alum, salt and either eggyolk or soluble oil, drying, and then coloring them with aniline dye and titanium-potassium oxalate.

The color of the leather can be modified by adding a solution of fustic or other dyewood to the gambier liquor; and the entire process may be reversed. The skins can be first drummed with alum and salt and then tanned with gambier. Heavy skins can be tanned with gambier, split and shaved, and then retanned with gambier, alum and salt. After the leather is dry it can be colored with acid or basic dyes, and, if not fat-liquored immediately after tanning, drummed with acid fat-liquor or with an emulsion of oil and soap, staked and finished.

Fat-Liquoring Vegetable-Tanned Calfskins.

The fat-liquors described in this section are suitable for quebracho, gambier, hemlock and combination tanned calfskins; and can be applied to the leather immediately after it is tanned or later, after it has been dried and colored.

1. For 200 lbs. of dry leather or 400 lbs. of wet leather weighed after washing and pressing from the tan, 7 or 8 gallons of this fat-liquor are sufficient. Borax chip soap, 24 lbs.; sal soda, 10 lbs.; treated cod oil, 15 gallons; birch oil, 2½ gallons. Boil the soap and sal soda in 5 pailfuls of water in a barrel until dissolved; next add the oils; stir and boil thoroughly; then add enough water to make 45 gallons of fat-liquor. This liquor, when made with birch oil, is excellent for colored leather; for black leather the birch oil may be omitted.

2. Sulphonated oil may be applied to leather either alone in solution with warm water, or mixed with neatsfoot oil or mineral oil in varying proportions, either as soon as the skins are tanned or after they have been colored; it may also be added to the tanning liquors in drum tanning and thus drummed into the leather. A practical formula is: Sulphonated castor oil 6½ lbs.; neatsfoot oil, 6½ lbs.; potash soap, 2½ lbs. Heat the neatsfoot oil to 160° F., dissolve the soap in

hot water. Stir the dissolved soap into the oil. Mix thoroughly; allow to cool slightly and add the sulphonated oil and mix thoroughly into an emulsion. This mixture dissolves readily in hot water and can be used in any quantity according to the degree of softness of leather that is desired.

A fat-liquor can also be made by mixing sulphonated oil and neatsfoot oil and a little ammonia. Sulphonated oil (neatsfoot), 50 parts; purified mineral oil, 25 parts; water, 50 parts, makes an emulsion that may be dissolved in hot water and drummed into the leather, brushed on, or added to tanning liquors in the drum, or to spent dye liquors.

3. For colored and black calfskins. Potash soft soap, 10 lbs.; neatsfoot oil, 4 gallons; French moellon degras, 10 lbs.

Boil the soap in 12 gallons of water. Cut the oil by pouring into it and stirring thoroughly 4 ozs. of borax dissolved in 1 quart of boiling water. Pour the oil into the soap and stir thoroughly. Then add the degras and stir thoroughly again. Run in enough cold water to make 50 gallons of fat-liquor. 10 gallons are enough for 50 average skins.

After the leather has been blacked or colored, press out the surplus water, and apply the fat-liquor at a temperature of 120° F., drumming the leather forty minutes. Remove the leather from the drum, horse it up for some hours, then strike it out and apply a coat of neatsfoot oil or other suitable oil and hang the skins up to dry.

Fat-liquoring may also be done after tanning and washing, the leather being then dried and subsequently dampened and colored.

The drum that is used for fat-liquoring should be heated with live steam; the water drained out, and the leather run in the drum a few minutes to warm it before the fat-liquor is given to it. It is always best to add the liquor in portions of a pailful at a time at intervals of five minutes until the requisite quantity has been fed to the leather.

4. Potash soft soap, 1¼ lbs.; moellon degras, 1 quart. This is for 110 pounds of wet leather. Use at 120° F., and drum the leather fifty minutes; then wash it; strike it out, and

hang it up to dry. When dry the leather can be sorted and finished into colors or black as may be desired.

5. To make a barrel of fat-liquor, use: Potash or chip soap, 4 lbs.; sal soda, 1½ lbs.; cod oil, 7 gallons; moellon degras, 1 gallon. Prepare in the usual manner and use at a temperature of 120° F. A barrelful of this liquor is sufficient for 300 lbs. of leather.

6. Potash soft soap, 25 lbs.; English sod oil, 50 lbs.; neatsfoot oil, 1½ gallons. A few pounds of degras may advantageously be added. Of this fat-liquor 20 gallons are required for 100 lbs. of dry leather.

Notes on Fat-liquoring.—In the manufacture of colored leather excellent results are obtained by drying the leather after washing and pressing it from the tan, then applying the first fat-liquor, which should be sulphonated oil. The leather is now dried, dampened, colored, dried again and then given the second and main fat-liquoring, which may be either sulphonated oil or an emulsion of soap, oil and degras.

Skins for black and colored leather, imitation kangaroo and dull and glazed boarded grains are also twice fat-liquored once after they have been retanned, pressed and sammied and again after coloring.

After the leather has been retanned, pressed and shaved, it should be uniformly sammied and fat-liquored and then dried. Imitation kangaroo and dull printed grains are generally yellow-backed before the second application of fat-liquor. Blue-backed is generally dyed or stained on the flesh and dyed on the grain afterward. Colored leather is usually given the second fat-liquor after it has been colored.

Fat-liquoring is one of the most important processes in the manufacture of leather. Only the best grades of materials should be used so that the leather will not be greasy or gummy or liable to spew after it is finished. Sulphonated oil unites with the fibers of the leather and does not decompose in the leather; it also prevents darkening of the grain and greasiness. Neatsfoot oil and cod oil, as well as other leather oils, combine with the fibers of the leather more readily than mineral oil

and form a sort of secondary tannage. The use of acid fat-liquor is recommended for light vegetable-tanned leather.

Dyeing Vegetable-tanned Calfskins Black.

Logwood Liquor.—For blacking leather logwood in some form is in general use. Logwood chips, logwood extract in paste, in solid and liquid forms are employed; also the powdered products of logwood such as Hematine, Hemolin and Hematoxylin.

When logwood paste is used, from 6 to 8 lbs. are dissolved in 40 gallons of water together with ½ lb. of borax or sal-soda, and brought to the boiling point. This liquor is very strong and is usually reduced in strength by the addition of more water.

Hematine and other similar products are used in the proportion of about 6 lbs. to a barrelful of water. The dye is first boiled a few minutes in one-half-barrelful of water, and the barrel is then filled with water. From 1 to 2 lbs. of borax may be added to the dye liquor. A few fustic chips or a few ounces of fustic paste or crystals boiled with the logwood serves to intensify the color.

The leather may be blacked in a drum, on a machine, on tables, or by being folded and passed through the dye in boxes or trays. Unless the flesh-side is wanted undyed the drum method is preferred, since a large number of skins can be blacked in a few minutes. The leather is first given the logwood liquor and then the striker.

Blacking with Logwood and the Salt of Titanium.—To color vegetable-tanned calfskins a deep black the use of titanium-potassium oxalate and logwood is recommended, 100 lbs. of dry leather requiring from 8 to 10 ozs. of the titanium salt. Dampen the dry leather and run it in a solution of 5 ozs. of the salt for ten minutes. Then pour alkaline logwood liquor into the drum and run the leather in it twenty minutes. Another solution of 5 ozs. of the titanium salt is then added to the liquor in the drum and drumming continued ten minutes, when both flesh and grain will be found to be colored.

If the leather is not fat-liquored before dyeing it should be washed, fat-liquored, dried and finished.

Dyeing with Direct Leather Blacks.—Methods of dyeing leather black by the application of special blacks, without the use of logwood, are of quite recent origin. Leather Black T B and T G patd. (Cassella) are useful in blacking any kind of vegetable-tanned leather either on the flesh-side only or upon both the flesh-side and grain. The color is a rich, permanent black. The dyestuffs are dissolved by mixing 2 parts by weight with 1 part by weight of acetic acid (30 per cent) and some water to a pulp, and then pouring boiling water over it, whilst constantly stirring, so that a solution of about one per cent. results, which is diluted if necessary. The dyestuffs are applied in the customary manner, either by the staining process or in a paddle or a drum without the addition of other ingredients. Special instructions are as follows:

1. If the flesh-side of the leather is to remain undyed the dye should be brushed onto the grain only. The color solution consists of 1 lb. of the black dye and 8 ozs. of acetic acid in 10 gallons of water. During its application the dye solution should be kept at a temperature of 120° to 140° F. Two applications of the black are generally sufficient to dye ordinary dry leather.

2. If the flesh-side of the leather is to be colored a blue, purple or bluish-black shade, the skins are first dyed with the dyestuff in the paddle or in the drum, which is done by drumming the leather with the color solution for one-half hour at about 115° F. The leather is then set out strongly, and, after it is dried, is subjected to the staining process or the brush blacking of the grain side only.

3. Where the flesh-side of the leather is also to be dyed black, both of the direct blacks are applied in the drum in the same manner as other basic colors. Usually 1 to 1¼ lbs. of dye for 100 lbs. of leather are required, and 3 to 5 ozs. of acetic acid are added to the necessary volume of water.

4. For dyeing the flesh blue, purplish blue or dark blue the following dyestuffs are particularly suitable for such preparatory coloring.

For a purplish-blue flesh.—Lanacyl Violet B pat.; Peri Wool Blue B pat. (These are acid colors, of which from 5 to 12 ozs. with the addition of 3 or 4 ozs. of sulphuric acid, or from 5 to 12 ozs. of acetic acid, are used per 100 lbs. of leather). Leather Black T B with the addition of a little Tannin Heliotrope.

For blue flesh.—Solid Blue R; Naphtol Blue R pat.; Naphtol Blue Black pat. (These are acid colors and are used in the same manner as the acid colors for purplish-blue flesh). Neutral Blue B; New Blue F L. For dark blue: Induline 3 B; Naphtol Blue Black pat. (Acid Colors); Leather Black T B pat.

The dyes not specified as acid colors are basic colors, which are dyed as usual with the addition of some acetic acid. According to the depth of shade required, up to 10 ozs. of dyestuffs are used for 100 lbs. of leather. The use of methyl violet color cannot be recommended for flesh coloring on account of its very poor fastness to rubbing and water. The Lanacyl colors are known commercially as Alizarine Lanacyl colors.

For blacking leather that is required to have a high gloss, the Leather Black T B pat. is especially well suited, whereas for leather with a dull finish the deeper and somewhat more greenish Leather Black T G pat. is to be given the preference. Cow hides and calfskins, which acquire a moderate polish by being rolled or strongly brushed, may be dyed equally well with either brand.

When dyeing with these direct dyeing blacks, no preparatory treatment or after treatment whatever is required; consequently no bottoming with logwood nor topping with iron salts is necessary. The dyes are applied direct to the leather.

Yellow Back.—After leather that is to be finished into imitation kangaroo, or other leather that is dyed yellow upon the flesh-side, has been fat-liquored and dried, the flesh can be colored yellow by using 5 lbs. of turmeric, 1 lb. of sal soda, 1 lb. of borax, 1 gallon of neatsfoot oil, boiled in 10 gallons of water; then fill the barrel up with cold water, and use 12 pailfuls of the liquor for a drumful of leather. After the flesh has been colored, dye the grain with sig, logwood liquor and iron striker; wash the leather and dry it for finishing.

Yellow flesh can also be obtained by using yellow aniline dye. The dry leather is dampened and placed in piles to become soft. One-half pailful of sumac is scalded for two hours in a closed vessel, and to the sumac thus prepared 11 parts of water and 1 gallon of lactracine are added. This quantity of liquor suffices for 125 skins. It is used at 100° F., and the leather is drummed with it twenty minutes, when it is ready for the yellow dye. Yellow S is a suitable color, 1 lb. of it being dissolved in 25 gallons of water and used at 100° F. The leather is then blacked on the grain, oiled off and dried; 4 pailfuls of the dye will color 100 lbs. of dry leather.

Dark Blue Flesh.—To obtain a dark blue or black flesh, drum the leather in an alkaline logwood and fustic liquor, then apply striker either in the drum or by hand, or on the grain side only.

To get a dark blue flesh with nigrosine, use 4 ozs. of the color for 12 skins. The dye is boiled in a few gallons of water and the leather is drummed with the solution twenty minutes. The grain is then blacked with logwood and striker, and the leather dried out. A good flesh color can also be obtained by using logwood liquor to which nigrosine black and methyl violet aniline have been added.

Acid and Basic Blacks.—A rich black may be produced by dyeing first with acid black and then topping with black; for instance, the black may be produced by dyeing with 2 per cent of Nerazine G, shaded if necessary with other dyestuffs, the requisite quantity of acid being added after about an hour's dyeing, and the leather is then topped with 1 per cent. direct leather black and the addition of some alum or acetic acid. The leather is then dyed for about twenty minutes, rinsed and set out, oiled and dried as customary. Where the leather is dyed by brushing on the dye or by the staining process, the solutions of acid blacks are brushed on without the addition of acid; the leather is then dried, and the second deep coloring given, this time with the addition of formic acid in order to fix the acid color.

A dense shade of black is produced with about 1 lb. of

Nerazine G, shaded if necessary, with orange, etc., and the addition of 8 ozs. of formic acid per 10 gallons of staining liquor, the leather being then dried. This treatment is followed by the application of another solution of 1 lb. leather black T B per 10 gallons of staining liquor. A preparatory treatment with titanium-potassium oxalate and an after treatment, if necessary, with a tanning solution enhance the fastness of the color to rubbing.

Strikers for Use after Logwood.—To develop the color of logwood to black, it is necessary to apply to the leather after the logwood has been brushed on a striker, which is commonly made of iron liquor, copper, etc.

1. 4½ lbs. of copperas and 1½ lbs. of blue vitriol, dissolved in 20 gallons of water by boiling. The barrel is then filled with water. For use in machine dyeing, 12 lbs. of copperas and 4 lbs. of blue vitriol are used for each barrelful of water. To this are added 1½ lbs. of ground nutgalls and 1 lb. of epsom salts to each 6 lbs. of copperas and blue vitriol combined.

2. 3 gallons iron liquor, 2 lbs. of copperas, dissolved and mixed together; ¾ lb. of verdigris dissolved in 2 quarts of vinegar and added to the copperas and iron liquor. Instead of verdigris 12 ozs. of bluestone dissolved in 2 quarts of boiling water may be used. The liquor should be well stirred and allowed to settle, only the clear liquor being used.

The Coloring of Vegetable-tanned Calfskins.

For the coloring of vegetable-tanned skins basic and acid dyestuffs are used. Acid dyes are applied with the addition of some acid, 4 parts of an acid color usually requiring 1 part by weight of sulphuric acid or 2 parts by weight of formic acid. The acid before it is given to the leather should be diluted with one hundred times its weight of water. The leather is first run in a drum with the solution of dyestuff and when it has taken up much of the color, in about fifteen minutes, the acid is poured into the drum and the leather drummed ten minutes longer. The use of formic acid is to be given the preference since this acid evaporates from the leather, while

sulphuric acid remains in the fibers and has a deteriorating effect upon the leather. Basic colors, apart from the amount of acid added in order to correct the hardness of the water, require no further addition whatever.

The leather is frequently freshened up with sumac before it is colored. When this is done it is apt to contain uncombined tannin, which causes uneven or cloudy coloring. To prevent such a result tartar emetic is used. The leather is first drummed with the sumac liquor. This may consist of a decoction of sumac leaves or powder or of a solution of 1 lb. of extract of sumac in sufficient water at 100° F. for four dozen skins. The leather is drummed with the sumac liquor twenty minutes. Then for the quantity of leather mentioned, 8 ozs. of tartar emetic dissolved in water are poured into the drum and the leather is run twenty minutes longer. The grain is thus cleared and prepared for the basic aniline dye. No bichromate of potash or other setting agent is required, as the color will be fixed upon the leather. It is advisable, however, to wash the leather before coloring it.

In the treatment of leather that has acquired a dark color from the tannage, it is advantageous to bleach it before coloring it.

Titanium Mordant of Colors.—Take 100 lbs. of dry leather and dampen and soften it with warm water. Then drum it in a solution of the dyestuff and fifteen minutes later pour into the drum a warm solution of 8 ozs. of titanium-potassium oxalate and run the drum twenty minutes longer. This method of coloring produces bright, even colors throughout the skins. The leather is then fat-liquored and finished as usual.

Another excellent coloring process is as follows: For each 100 lbs. of dry leather, washed and cleaned, start the dye bath with 1 to 3 lbs. of phosphine dyestuff and 1 to 8 ozs. of shading brown dye, according to the depth of shade required. Drum the skins in the bath one-half hour. Pour into the drum while it is in motion, 4 to 10 ozs. of titanium-potassium oxalate dissolved in hot water and drum ten minutes; then rinse the leather, set it out and tack it to dry.

To each dozen skins of about 100 sq. feet, the quantities of of dye are as follows: 2 to 6 ozs. of phosphine with ⅛ to 1 oz. of shading brown are used; also ½ to 1½ ozs. of the salt of titanium.

Good colors can be obtained by using the following method of dyeing: The leather, washed and cleaned, is drummed in a solution of sumac, 2 per cent. of it in sufficient water to drum nicely, for one-half hour. One-half per cent. of tartar emetic dissolved in hot water is next added and the drumming continued another half-hour. The leather is then washed and the color solution prepared, either basic or acid colors being used. If the latter 4 per cent. of formic acid should be added to the liquor toward the end of the operation. The leather should be drummed in the dye until it is evenly colored, the solution of dye being added in portions of one-third and the drumming continued one-half hour. The leather is then washed and fat-liquored with 1 to 4 per cent. of sulphonated oil, set out carefully, oiled and tacked in frames to dry.

Finishing consists of dampening and staking the leather and either glazing or ironing it according to whether bright or dull finish is wanted.

For fat-liquoring the leather Turkey Red oil (sulphonated castor oil) is particularly suitable, used either alone or combined with neatsfoot oil.

Velvet and Suede Leathers.

These leathers are produced out of almost all kinds of skins, and there are various ways of manufacturing them. The skins intended from the start for this purpose are worked through the beamhouse and tanned expressly for this finish, but how to get such leather out of a skin that was tanned in bark or some other vegetable tannage is an entirely different matter. The skins are assorted, and those which have poor grain and other imperfections are thrown aside. When there is enough to make a batch of ten or twenty dozen, the skins are washed out with warm water and cleansed. The surplus water is then struck out of them and they are ground on

BEAM ROOM IN A CALFSKIN TANNERY.

To face page 152

stones made for the purpose. After this has been done they are retanned in a light solution of sumac, which also acts as a mordant for the coloring. The skins may be colored in a tray or wheel, after which they are fat-liquored and dried. They can be washed out, retanned, then ground, colored and fat-liquored, dried, staked and ironed. Care must be taken that the iron is not too hot or it will scorch the nap and make it shiny. If rolled instead, they should be rolled on the unfinished side, which is simply to flatten out the skins.

Another way is to emery the skins first on regular buffing wheels dry. Then they are treated as suggested above. But these skins never have such a close nap as those that are ground wet on stones.

When velvet or suede leather is to be made from sumac or extract-tanned skins, the goods are fluffed on the flesh side and the grain receives a thorough grounding or buffing on a buffing wheel. Another method is to stake them lightly and then to buff lightly on a buffing machine. At the beginning of the dyeing operations the skins are run in the paddle or drum for fifteen minutes in lukewarm water; they are next treated to a weak acid bath, one-fourth per cent. or less of sulphuric acid, and are run in this for a period of twenty minutes in order to clear them. The leather is then rinsed and given a light retannage of 1 to 1½ per cent. of sumac extract in a drum, and it is then colored.

Coloring is done most satisfactorily with acid dyestuffs. The dye bath is prepared in the usual manner and to it ¼ lb. of potato starch is added for 100 lbs. of leather to insure evenness of color and to cover imperfections. At the end of twenty minutes in the dye bath, acidulate with ¼ per cent. of sulphuric acid, rinse the dyed leather, set it out and dry it in the usual manner.

Finishing is done as follows: Dampen the skins with clean damp sawdust and next stake it; then buff on the buffing machine and fluff lightly on the flesh. In place of buffing on the wheel, the skins may be lightly worked over with the knife by hand, finishing off by working over the grain with a very

fine emery made up into a suitable pad. The latter method gives an even, velvety feel and appearance to the leather. The finishing touch is a brushing with a stiff brush.

For vegetable-tanned goods which are to be stained on the flesh only, the buffing in the first stage applies; when buffed they can be treated as follows: First give the skins a coat of "clearing," made by dissolving 2 ozs. of oxalic acid in 3 or 4 gallons of water. Allow them to level well by lightly airing, and then work over with a light coat of stain, using in the dyestuff solution 4 ozs. of dextrine and 4 ozs. of gum dragon in 8 to 10 gallons of solution. In staining this class of goods, it is the rule to give a first weak coat in order to insure a more even absorption of coloring matter, finally working up the shade required in the second coat. For producing good shades in light browns, the use of titanium-potassium oxalate will serve a useful purpose in obtaining a bottom which is really rich, using about 3 ozs. of the salt to 100 lbs. of leather, drumming the skins with the solution for twenty minutes, and then adding the color solution to the contents of the drum.

A light crutching and rubbing up the velvet on the colored side with a fine emery pad, or a light buffing on the wheel finishes the leather. Coloring the skins according to the following method produces very deep penetration of color. The leather is buffed dry and soaked. It is then dyed warm in the drum with acid colors, some ammonia being added at the beginning of the dyeing operation. According to the thickness of the leather up to 5 per cent. of dyestuff, calculated on the weight of the moist leather, is used. The skins are dyed one hour; the requisite quantity of sulphuric or formic acid, up to ½ per cent., being added towards the end of the dyeing operation. The leather is then rinsed thoroughly, set out, oiled and dried and finished in the usual manner by moistening in damp sawdust, drumming in a dry drum and glazing or ironing on the grain side.

Black is produced by dyeing with 2 per cent. of Nerazine G, shaded if necessary, with other dyestuffs, the requisite

quantity of acid being added after about an hour's dyeing, and the leather topped with 1 per cent. of velvet black and the addition of some alum or acetic acid. It is then dyed twenty minutes, rinsed, set out, oiled, dried and finished.

Coloring Quebracho-tanned Skins.

When fully tanned the skins should be washed and pressed and fat-liquored with Turkey red oil or acid fat-liquor, from 1 to 2 per cent. of the same being sufficient for 100 lbs. of leather and used at a temperature of 110° F. The skins are then washed again, set out, shaved and hung up to dry. A light fat-liquor of soap and oil also is good but there are advantages in the use of sulphonated oil. After having been in the crust a week or two the skins should be sorted for coloring. Very greasy skins are degreased before they are colored. To prepare the skins for coloring wash them in water in a drum to clean the grain. Clear and light-colored skins can be treated at once with sumac; those that are somewhat dark should be cleared with sulphuric acid or formic acid, using about 1 lb. of acid in 12 gallons of water and washing the leather for twenty minutes. One pint of acid may be used for ten dozen skins in warm water in a paddle or a drum, the acid being next removed by washing in water.

The next operation is the sumac bath. From 2 to 3 lbs. of sumac, well scalded, are used for 100 lbs. of leather. The skins are drummed with this sumac for one-half hour, or paddled in it one hour. The drum is the preferred method. One-half pound of tartar emetic is now dissolved and added to the liquor and the leather is drummed one-half hour longer. The plugs are next drawn and the stock is thoroughly rinsed. Very greasy skins should be degreased with naphtha before they are colored. A drumming in a weak lactic acid bath is beneficial to skins that are only moderately greasy.

One method of coloring is carried out in the following manner: The skins, rinsed from the sumac bath, are ready to be colored. Acid dyes and formic acid are preferable for this class of leather. The dye liquor is prepared by boiling the

dyestuff in the usual manner; and the acid may be added directly to it or poured into the drum in diluted form after the skins have been drumming fifteen minutes, 4 ozs. of the acid being used for 100 lbs. of leather. There should be 12 gallons of dye liquor. Water warmed to 120° F. is put in together with the leather and the drum is set in motion. One third of the color bath is added through the trunnion, and drummed three minutes; a second third is added and run two minutes; finally the last portion is poured in, and the drumming is continued one-half hour, the acid being added after the last portion has been in a few minutes. It may be added to the dye liquor at the beginning of the process if desired. The leather is next washed; and if it was not fat-liquored after tanning it is now fat-liquored with 1 to 4 per cent. of Turkey red oil. It is next set out; a light application of oil and glycerine is applied to the grain and it is either hung up to dry or tacked on boards or in frames and dried.

The skins are next trimmed and finished. A coat of finishing ink or seasoning is applied to the grain with a sponge; and before the grain is quite dry the skins are rolled, brushed and staked. If bright finish is wanted a coat of glaze seasoning is applied and dried, and the skins are then glazed.

If ooze leather is wanted, the skins should be dried after tanning and carefully buffed on the flesh-side, first using a coarse, and later on, a very fine emery on the wheel. The skins are next colored the same as grain leather, fat-liquored with Turkey red oil, set out on the flesh side and tacked to dry. Upon being taken off the boards the leather is trimmed, staked lightly and dry drummed.

Another good coloring process consists of mordanting the skins after they have been cleared with acid and drummed in sumac, with a solution of fustic extract and titanium salt, then applying the solution of dye. Skins for black leather are fat-liquored with suitable fat-liquor and dried; they are then dyed on flesh and grain, dried, staked, seasoned and finished.

Notes on Ooze Calf and Russia Chrome Leathers.—Chrome-tanned calfskins are finished into several fancy leathers. The most important of these are the boarded tan calf, chrome Russias, and ooze in black and colors. The skins for boarded tan calf and chrome Russia are selected in the wet tanned condition and colored before they are dried out.

The skins for ooze leather are fat-liquored after tanning with an emulsion of eggyolk and flour and then dried; after this they are sorted and colored. The fancy ooze colors, according to a writer in the "Leather Manufacturer," can be made by bottoming with sumac or fustic extract and some mordant like sulphate of iron, tartar emetic or titanium-potassium oxalate, then coloring with basic dyes; or by coloring with acid or diamine dyes and sometimes topping with basic dyes. Some light shades are also made with pigments.

Black ooze is made with a combination of logwood, nerazine or oxydiamine black and leather black, or with a combination of developed black and leather black. One process of making black ooze calf is as follows: The skins are sorted after washing out of the chrome tannage. They are next shaved and fat-liquored thirty minutes with 5 per cent. eggyolk and 10 per cent. flour. The skins are then drained off, hung up and dried. When dry, they are dampened in sawdust, staked and buffed. They are then ready for dyeing. The skins must be buffed very clean so that after they are colored they will not need a second buffing. The next operation is a thorough wetting in a drum with water at 140° F. Next the skins are dyed thirty minutes at 130 F. with 12½ per cent. diamine ooze black C R, then fixed fifteen minutes with 5 per cent. muriatic acid. The skins are next drained off and rinsed in cold water. They are then diazotized, running first five minutes in 10 per cent. muriatic acid. Then add, and run them fifteen minutes, in 5 per cent. nitrite of soda, drain them off, and wash thoroughly.

The muriatic acid is given before the nitrite of soda because the latter has an alkaline reaction, which has a tendency to wash the black from the leather before it can be diazotized.

The diazotizing must be done cold so that the nitrous gas will not escape easily from the solution.

The skins are now developed fifteen minutes with 0.8 per cent. phenylene-diamine dissolved with 1.6 per cent. soda ash and 0.2 per cent. betanaphthol dissolved with 0.2 per cent. caustic soda. The two solutions are made separately but are mixed before they are applied. The skins are then drained off and washed and next topped with 2 per cent. leather black No. 60763, ½ per cent. acetic acid. The skins are then thoroughly rinsed off and fat-liquored forty-five minutes with 2 per cent. fat-liquor. They are then dried on hooks, dampened in sawdust, staked, dry milled, and tacked out. Chrome Russia leather and tan chrome boarded calf are colored in about the same manner. Tan boarded leather being glazed, it is necessary to keep the colors lighter and yellower because the glazing makes them sadder and redder. These colors are usually made with basic dyes on top of a vegetable bottom, because they give very full, even shades. Acid and diamine colors can be selected which would be much faster to light.

Basic dyes are usually applied as follows: The skins are first neutalized twenty minutes with ½ per cent. borax and rinsed thoroughly. They are then drummed thirty minutes with 5 per cent. sumac or fustic extract. A solution of ¼ per cent. tartar emetic or titanium salt is next run in and the leather is drummed twenty minutes; this fixes the bottom. Drain off and rinse well.

Coloring is done with a mixture of Diamond phosphine G G, R, or D, Bismarck brown E E, new blue R; and the color is set with ⅛ per cent. bichromate of potash. Drain off and rinse well. Fat-liquor with 6 per cent. acid fat-liquor.

Chrome-tanned side leather in tan, chocolate and green shades for sporting shoes is in considerable demand. The leather is usually neutralized and then given a retanning with sumac extract, ¼ per cent. tartar emetic and 2 per cent. acid fat-liquor and dried on hooks. Then the sides are sorted for the different shades, wet up and sometimes retanned with 5 per cent. fustic or sumac extract, then dyed with ½ to 1 per

cent. of a mixture of Diamond phosphine G G, Diamond phosphine R, Bismarck brown F E, Cerise N, solid green O crystals. These colors will produce any of the tan, brown, oxblood or green shades into which this kind of leather is made.

The color is sometimes fixed with $\frac{1}{8}$ per cent. bichromate of potash and fat-liquored with 5 per cent. acid fat-liquor.

Vegetable-tanned leathers are usually colored with basic dyes, except very light pearl and ecru shades, which can be dyed better with easy-levelling acid dyes. The principal difference in treating the different kinds of vegetable-tanned leathers is in the method of preparation for coloring. The dyeing operations are usually carried on at about 110° F.

SECTION THREE.

The Tanning and Dyeing of Furs and Hair Skins.

Soaking the Skins.—Soft, green-salted skins to be tanned with the fur or hair on them require but two or three hours soaking in clean water to become soft and clean. Dry skins are soaked and softened most effectively in water to which borax, caustic soda or formic acid has been added. A solution of 2 lbs. of borax in 100 gallons of water is a suitable soak for dry skins. Well-cured skins can be softened in a soak consisting of 100 gallons of water to which 1 lb. of caustic soda has been added. An excellent soak is also prepared by adding 1 to 2 lbs. of formic acid to 100 gallons of water. This is an approved method of soaking since the acid has antiseptic properties and will not allow decay to take place. The water used for soaking should always be fresh and clean; and the soaking should be done as quickly as possible to avoid decomposition and loosening of the hair. When soft and clean the skins are fleshed and all lumps of fat and flesh removed. The skins should next be washed in a warm solution of soft soap, which makes the hair and the skin itself clean and free from grease; they are then ready to be tanned.

Another method of preparing the skins is as follows: They are taken in raw condition and beamed and scraped on the flesh side until they are free from flesh and greasy matter. They are not soaked at first. Softening is done with wet sawdust. Soak some sawdust in water. Spread the skins out smoothly, flesh side up, and spread the wet sawdust an inch deep on the flesh side and let them lay until they are softened. In the case of greasy skins it is necessary to soak them in borax water and then to wash them in warm sal soda solution, omitting the sawdust treatment. When soft, fleshed and clean, the skins are ready to be tanned.

Tanning the Skins.—1. M. C. Lamb, an authority on tanning, has described a method of tanning fur skins, which has advantages over the common alum tannage. The process is partly mineral and partly vegetable; and skins tanned with it are soft and durable. The method consists of applying to the flesh-side of the skins a mixture made of alum, salt, gambier and glycerine. The formula is: Aluminum sulphate, 5 lbs.; common salt, 5 lbs.; gambier, 2 lbs.; rye flour, $\frac{5}{6}$ lb.; water, 10 gallons. Dissolve the aluminum sulphate and salt in a small quantity of water. Boil the gambier until it is dissolved and mix the two solutions. The rye flour is made into a thin paste with lukewarm water; the oil or glycerine is added to the flour paste; and finally the alum, salt and gambier solution is added and the whole thoroughly mixed together to a thin pastelike mixture. To this mixture $\frac{1}{2}$ to 1 lb. of glycerine or the same quantity of olive oil is added to make the skins softer. This addition is particularly essential when the skins are naturally of hard texture and do not possess much natural grease.

The paste is then applied to the flesh-side of the skin with a brush to the thickness of about one-eighth of an inch. The skins are then folded or placed flesh-side to flesh-side, and after lying for some time and perhaps receiving another application of the paste, are hung up to dry.

2. Another excellent alum process is described in the following words in the *Shoe and Leather Reporter*: For the tanning liquor, dissolve 5 lbs. of alum and 6 lbs. of salt in 12 gallons of hot water. If the skins are greasy the addition of $\frac{1}{2}$ lb. of borax to the liquor is to be recommended. The liquor should be warmed to 95° F., and the skins be moved up and down in the liquor, especially at first, to make the tanning uniform. After twenty-four hours the skins should be removed and pasted on the flesh-side with a paste made of alum, salt and flour. The preliminary treatment with alum and salt may be omitted, but for uniform results and for greasy skins, it is best to use it. The paste is made as follows: The skins to be tanned are weighed, and the following quantities

are used for 100 lbs. of them : Alum, 4 lbs.; salt, 3 lbs.; flour, 4 lbs.; eggyolk, 1 lb.; olive oil, 1 lb.

The flour is made into a paste with water; the alum and salt are dissolved separately in boiling water. When the solution is cool the flour paste is stirred into it, and after the mixture has been thoroughly stirred the eggyolk and olive oil are stirred in. The primary object of the flour is to obtain a mixture in a semi-pasty form so that it will adhere to the skins. If the above quantity is not sufficient to make the mixture sufficiently pasty, either less water should be used in dissolving the alum and salt, or more flour should be used in making the flour paste. The flour also helps to give fuller leather. The eggyolk and olive oil give softness to the skins. For the finer furs a small quantity of eggyolk is essential. Where economy is desired olive oil may be substituted for the eggyolk with similar results. Instead of giving a preliminary treatment in alum liquors, the tannage may consist of the application of the paste only. The skins should be allowed to lay some time with alum paste adhering to them; this makes the tannage more complete and permanent.

If it is desired to dye the furs with acid colors it is necessary to wash them after they have been dried and worked soft, and retan them with chrome liquor.

3. Soft, white, well-tanned skins are obtained by tanning with a paste of alum, salt and oatmeal. Heat 1 gallon of rain water and stir into it enough pulverized alum to make a very puckery solution ; then add one-half as much salt as alum and boil until the alum and salt are dissolved. While the solution is boiling, add ½ lb. of rolled oats, boil fifteen minutes, and then set the paste aside to cool. By adding a few ounces of gambier to the liquor and boiling together, the skins may be given a light yellow color.

The cleaned and softened skins are spread out, flesh side up, on a table and a heavy coat of the prepared paste is applied with a brush. This painting is repeated every day until the skins are tanned, which takes from two to six days, according to their thickness. When tanned the skins are hung up to

dry, then stretched and worked out soft and white. The fur is cleaned with dry, hot sawdust. The flesh is made perfectly clean and smooth by buffing on an emery wheel.

Cleaning the fur can be done in a drum or cage when a large number of skins are to be cleaned ; on a small scale they may be tramped on or pounded in a barrel or tub, or be cleaned by brushing the hot sawdust into the fur with the hands, and then beating it out with a switch until the fur is clean and bright. Sawdust of hard wood is better than that of pine for the purpose.

Washing Greasy Skins.—Skins that contain a good deal of natural grease should be washed in a warm solution of sal soda and then scraped over the beam, and the grease forced out of them. Dogskins should be fleshed dry, that is, before they are soaked, as they then flesh more easily than after soaking. After they have been fleshed they are soaked and washed preparatory to being tanned.

To wash greasy skins prepare a warm solution of sal soda by dissolving sal soda in water heated to 90° F. Dip the skins into this solution long enough to get them wet and hot, then put them upon the beam and go over them with a flesher or dull knife, bearing down hard and forcing the grease out. The dipping and scraping may be repeated until the skins are free from grease. They are then rinsed, drained and tanned.

Oil Process.—Furs can be tanned very satisfactorily with seal oil. Lamb describes this process as follows: The goods are first freed from superfluous moisture by draining or hydro-extracting, and are then rubbed over on the flesh with a good quality of seal oil. The skins are folded into cushions, flesh side innermost, and placed in a large wooden tub. The impregnation of the skins with the oil is facilitated by a workman treading the goods with his bare feet, thoroughly trampling the skins down and thereby working the oil into them. The goods, after being worked in this way, are left for several hours, and then another application is made, and the process repeated. When the goods have become thoroughly

impregnated with the oil they are laid in a pile. Care must be taken that they do not reach a temperature higher than 38° and 40° C. (100° to 104° F.). A tannage effected in this way is somewhat similar to that used in the dressing of chamois leather and is dependent on the decomposition of the oil and the production of aldehydes. When thoroughly tanned the goods are rinsed through a weak alkaline solution for the purpose of removing undecomposed oil and grease, and are subsequently dried. This is the so-called Furriers' Dress Process.

Oiling Alum-tanned Skins.—Skins that have been tanned with an alum paste containing oil or eggyolk do not require further oiling to make them soft, but where no oil is used in the tanning paste it is advisable to apply a coat of oil after the skins have been tanned and dressed down, or partly dried. Sulphonated neatsfoot oil is satisfactory; a good mineral oil also. Mop the oil over the flesh of the skins; let lie on a pile a day or two, then hang them up to dry. Working out and cleaning in sawdust complete the work.

A solution of soap, also one of stearine, is recommended for alum-tanned skins. The use of either of these fixes the tannage and makes it more permanent.

A Method of Degreasing.—Dogskins that are very greasy should be washed well in warm sal-soda water before they are tanned, next tanned with alum and salt, rinsed and drained and then tacked out while wet upon boards or stretched in frames and given upon the flesh-side a paste made of whiting and water. This should be applied quite thick, and the skins are then placed in a warm room and dried. In drying, the whiting absorbs the grease. The paste should then be scraped off and another coat put on and dried. The operation is repeated twice, three, and even four, times until the grease is entirely absorbed and the paste dries white. When the skins are free from grease, scrape off the whiting and wash the flesh. Next apply either a tanning paste, or put the skins into a tanning liquor to retan them; then dry and finish them in the usual manner. The retannage can also be a dry mixture of pulverized alum and fine salt rubbed into the wet skin.

Deodorizing Furs and Rugs.—The following solution is useful for removing objectionable odor from furs, rugs, etc. Into 4 gallons of water put 8 lbs of tanner's soap, or any other good bar soap, chipped fine. Add 7 lbs. of sal soda. Boil until the soap and soda are dissolved ; while the solution is hot add 1½ ozs. of borax, ¾ oz. of sulphate of soda and 1 oz. of oil of sassafras. Put the solution aside to cool and it is then ready for use. This liquor can be used on skunk skins, but they should not be rinsed out before tanning. After the skins have been dried and cleaned it will be found that they have no more bad odor.

How to Clean Furs.—Dark furs may be cleaned with bran or with cedar, mahogany or other hardwood sawdust, which has been warmed. Beat the fur gently with a switch and brush it until it is free from dust, then lay it on a table with the fur side up and rub the hot sawdust or bran through the fur. Use plenty of sawdust and rub vigorously. After this beat and brush the fur until it is free from sawdust or bran and is clean and fluffy. White furs can be cleaned in the same manner except that white cornmeal is used instead of sawdust. The cornmeal should be used warm. Soiled places may be cleaned by rubbing with cube magnesia. Allow the powder to remain in the fur for a day, then brush it out thoroughly.

Professional cleaners clean fur garments, muffs, etc., by dipping into gasoline until they are clean, then drying, and smoothing by the use of hard bread crust, passing same lightly with the grain of the fur.

Liming.— Where the skins are subjected to a liming process before they are tanned they work out very soft and elastic. In this case, however, liming is a process different from liming for leather. In the latter process the hair is loosened but in liming fur skins and sheep pelts the hair or wool is not affected. The process is as follows : A solution of 1½ per cent. of caustic soda is made into a thin paste by the addition of French chalk, china clay or some inert material of this description. The paste is applied to the flesh side, the skins folded up, flesh in,

and allowed to stand four or five hours. They are then thrown into a 4 per cent. solution of calcium chloride (4 lbs. calcium chloride in 10 gallons of water) and left several hours, usually over night. The skins should then be washed in water in a drum and delimed with lactic or formic acid. About 4 ozs. of acid per dozen skins will usually be found sufficient, but more may be used without damage to the skins. The skins are now made ready for tanning.

Chrome-tanned Furs and Woolskins.—In order that the tannage of furs and woolskins may be permanent, that is, not affected by moisture, and the leather made as durable as possible, it is advisable to tan alum-tanned goods with one-bath chrome liquor. A commercial liquor may be used or a solution of chrome alum and soda. Where furs are to be dyed in hot dye-liquors ½ lb. of formaldehyde should be added to 10 gallons of chrome liquor to increase the resistance of the skins to heat. A practical liquor is made by dissolving 5 lbs. of chrome alum in 10 gallons of water and adding to the solution ½ lb. of formaldehyde. This is heated to 70° F., and the skins are placed in it and paddled in it two hours or drummed with it one hour. At the end of the time stated 3 lbs. of washing soda are dissolved, the solution is added to the liquor and the process continued an hour or two longer in the drum, or the skins are left in the liquor from twelve to twenty-four hours in a paddle, drained several hours, and then, if they are not to be dyed, are neutralized by being washed in water containing 2 or 3 per cent. of borax, reckoned on the wet weight of the skins, in sufficient water to wash the furs nicely. After this has been done the skins are well washed with clean water.

After the furs have drained well a fat-liquor is applied to the flesh side. Any light chrome leather fat-liquor may be used, or a solution of sulphonated oil; the fat-liquor may be applied in a drum or brushed onto the skins. Instead of applying the liquor in a drum, a hot solution of sulphonated oil and flour, or of the oil alone, or a mixture of eggyolk and flour may be applied to the flesh side, the skins folded and left un-

til the next day and then hung up, and dried. Any fat-liquor that is suitable for light leather such as sheepskins may be used. And for the chrome tanning any good one-bath liquor is suitable. An excellent method of chrome tanning furs, hair skins and sheep pelts is carried out in the following manner: The skins are soaked, fleshed and washed clean; they are next limed with caustic soda and calcium chloride in the manner previously described, then delimed with lactic or formic acid and tanned.

The first step of the process consists of a solution of alum and salt, 2½ lbs. of alum and 1 or 2 lbs. of salt in 5 gallons of boiling water. When the solution has cooled down to 75° F. the skins are immersed in it and stirred about one hour, then allowed to remain in the solution from twelve to twenty-four hours. A few pounds of salt and 3 or 4 gallons of chrome liquor are added to each 100 gallons of water. A smaller bath can be used by keeping the same proportions. As the skins absorb the tanning material, more concentrated chrome liquor should be added, and the goods be left in the solution until they are tanned through. When the green color has penetrated throughout the thickest skins, a few ounces of bicarbonate of soda should be added to the liquor and the skins left in a day longer. They are next washed in borax water, then in clean water, drained, fat-liquored and dried, or dyed immediately after the tannage is completed. A paste made of soil, oil and flour forms a suitable fat-liquor.

In addition to the formula for the chrome liquor that has been given, the following has been found suitable for the purpose. Either liquor may be used in tanning skins from the alum and salt bath, or those that have been previously alum tanned, dried and washed back for retanning. Dissolve 100 lbs. of sodium bichromate in 2 gallons of water; add to this 100 lbs. of sulphuric acid, and then add slowly 6 lbs. of syrup glucose in portions, waiting after each addition for the agitation to subside. 15 lbs. of this liquor will tan or retan 100 or more lbs. of skins, ½ lb. of formaldehyde being added to each 10 gallons of diluted tan liquor used in the paddle or drum.

Tanning Hair Skins with Alum and Gambier.—For the tanning of hair skins for rugs, robes and mittens a tannage of alum and salt and either gambier or quebracho is satisfactory. The skins are soaked, fleshed, washed and spread upon a table and a mixture of pulverized alum and fine salt is rubbed into the flesh side with a brush until all spots are covered. Each skin is then folded down the center, or rolled up and left in that condition for twenty-four hours. A second application of alum and salt is then brushed in and the skins are left in piles a day or two longer. This treatment sets the hair so that it will not slip during the subsequent treatment. The skins may be dried and finished without further tanning, but a treatment with gambier or quebracho liquor makes a more permanent tannage and more durable leather.

A fairly strong liquor is made by boiling either gambier or quebracho extract, and when it is cold the skins are immersed in it and left in it several days, according to their thickness. The liquor should be rather weak at first and strengthened as the skins absorb the tan.

The goods are then washed, drained and either hung up or stretched in frames to dry. When the excess of moisture has evaporated, warm oil should be applied to the flesh and brushed in. Any good leather oil may be used, sulphonated oil being especially good. When thoroughly dry the skins are beaten and brushed until the leather is soft and the hair clean.

The above-described method of tanning can also be used for making leather for aprons, etc., the hair being removed and the skins prepared in the regular manner.

To Clean White Fur Rugs.—White fur rugs and wool rugs may be cleaned by the application of a paste of powdered chalk and water, prepared by mixing the two into a thin paste and then rubbing the latter thoroughly into the fur or wool and allowing it to dry. When dry, the paste is thoroughly brushed out with a stiff brush, and to finish a finer brush is used to remove every particle of chalk. This treatment takes away all dirt and grease and causes the goods to be clean, soft and fluffy.

To Bleach Skins with the Hair On.—Goatskins, sheepskins and lambskins that are intended for rugs, robes, etc., can be bleached by using a solution prepared in the following manner: 4½ lbs. of chloride of lime are mixed into 21 quarts of water, the solution being stirred for some time. It is then allowed to stand until it has settled, when the clear liquor is drawn off into a solution of 5½ lbs. of Glauber's salt in 10½ quarts of water. A precipitation results which leaves hypochlorite of soda in solution. The clear liquor, which should be quite free from lime, is next drawn off and the skins are immersed therein until they are bleached, which takes about two days. They should next be rinsed in water and then washed in weak suds of white soap to give the necessary soft feel. Previous to bleaching the skins should be washed with warm suds and rinsed. Alum-tanned skins may require a retannage after bleaching. This is done by rubbing powdered alum and salt or a paste of the same to the flesh side before hanging the skins up to dry.

To Dye China Goatskins Black.—China goatskins are imported into the United States tanned and made up into rugs. The process of dyeing such rugs black is carried out in the following manner: The quantities of dyeing materials mentioned are for 60 rugs, which is equivalent to 120 skins. In a vat of about 360 gallons capacity, make up a bath of 24 lbs. concentrated ammonia and 36 lbs. of common soda, previously dissolved. When these have been added to the water, heat up to 95° F., and immerse the rugs for two hours, stirring them occasionally. Then pull them up and let them drain well.

Dissolve 50 lbs. of dark turmeric; boil 45 lbs. of logwood extract, and add all to the bath. Throw the rugs in and leave them in the liquor until they rise to the surface. Then haul them out and add 25 lbs. of logwood extract, 10 lbs. of sumac, 10 lbs. of bluestone (sulphate of copper), 5 lbs. of fustic extract, and 3 pailfuls or about 60 lbs. of acetate of iron; stir up well and immerse the rugs for eighteen hours; then draw them up and expose them to the air for twelve hours. Next

heat the liquor up again to 95° F. and put the skins back for twelve hours more. Draw them out of the liquor; hang them in the air for a time, and then wash them. The washing should be very thorough with plenty of clean water until all dirt and superfluous dyestuff are removed; the rugs should then be wrung and tacked out to dry. When almost dry, put them into a drum together with a mixture of silver sand and mahogany dust and run them four hours, after which they should be put into an open slat wheel or cage and be run for two hours to clean out the sand and dust and to finish them off. The latter process, if carried out properly, will be found to give an added brilliancy to the fur which cannot be obtained in any other way.

Dyeing Furs with Acid Colors.—The use of acid dyestuffs is to be preferred to the use of basic colors in the dyeing of furs, hairskins, rugs, etc., because of their greater fastness to washing and rubbing. The skins can be dyed black or fancy colors with acid dyes. But in order that they may stand without injury the high temperature of the dye bath it is necessary to retan them with a chrome tannage. Such a tannage not only increases the resistance of the furs to the hot dye bath but it also makes them more waterproof and more durable. Alum-tanned skins particularly require such tannage. They are washed clean and are then ready for the process.

A satisfactory chrome liquor is made by dissolving 5 lbs. of chrome alum in 10 gallons of water and adding to the solution ½ lb. of formaldehyde, which increases the resistance of the skins to the heat of the dye bath. The temperature of the chrome liquor should be about 70° F.; and the skins should be placed in it in such a manner that the flesh side is fully exposed to the liquor. If thrown in loosely they should be stirred about frequently and kept opened out. It is well to suspend large skins in the bath so that the flesh will get the full benefit of the retannage.

After having been in the liquor two hours the skins should be lifted out and a solution of 14½ ozs. of soda ash is then added. The liquor is stirred thoroughly and the skins are

put back and left in the liquor twenty-four hours or longer, or until the retannage is complete. They are then drained twelve hours and rinsed.

Any good one-bath liquor may be used in place of the solution of chrome alum; but no matter what liquor is used there should be added to every 10 gallons of it ½ lb. of formaldehyde.

A suitable chrome liquor is made by dissolving 8 lbs. of chrome alum in 10 gallons of water and adding thereto 1½ lbs. of soda ash or 3 lbs. of soda crystals diluted with ½ lb. of formaldehyde.

The Chlorinating of the Furs.—In order to impart to the skins greater affinity for the dyestuff it is necessary to treat them with chloride of lime in the following manner: A bath is prepared consisting of 1 lb. of hydrochloric acid in 10 gallons of cold water; the skins, while still wet, are immersed and stirred about in this bath for fifteen minutes; then, without rinsing, they are passed into a chloride of lime bath. This consists of the clear solution of 12 or 14 ozs. of chloride of lime added in four portions to 10 gallons of water. The furs are treated in this bath for one hour; they are then reentered into the first bath and worked therein for fifteen minutes. They are then rinsed in lukewarm water, to 10 gallons of which 3 to 5 ozs. of hyposulphite, or thiosulphate of soda, or bisulphate of soda have been added. This removes the last trace of chlorine. After the skins have been allowed to drain well they are dyed.

Dyeing the Furs with Acid Colors.—For 100 lbs. of furs from 10 to 20 lbs. of Glauber's salt, 2 to 5 lbs. of acetic acid, and the requisite quantity of dyestuff in solution are added to water heated to 120° F., and the furs are placed in the prepared bath. The temperature of the bath is gradually raised by steam to 165° F.; and after one-half hour from 6 to 8 lbs. of bisulphate of soda are added in two or three portions, and the skins are worked at the same temperature for thirty minutes; they are then rinsed thoroughly and drained or hydroextracted.

After the furs have been rinsed it is advisable to pass them through a solution of soap and oil, which imparts a soft feel

to the hair. The solution is made of 1 lb. of olive oil soap, 2 or 3 ozs. of olive oil and 1 or 2 ozs. of ammonia in 10 gallons of water. The furs are worked in this solution fifteen minutes or longer and are then drained or hydroextracted and dried without rinsing. When dry they are worked out soft and cleaned.

A rich black is obtained by dyeing the furs in the manner that has been described with from 4 to 6 per cent., calculated on the dry weight of the skins, of the following (Cassella) dyes: Naphthylamine Black S, E S N, S S 2 B; Naphthylamine Blue Black B, B D; Naphthol Black B, S G; Azo Merino Black B. As shading dyestuffs for black, the following are used: Indian Yellow F F; Tropaeoline O O; Acid Yellow A T; Fast Yellow S; Orange 11, extra.

For blue shades: Cyanole F F extra; Tetra Cyanole V; Indigo Blue N; Azo Wood Blue S E; Naphthol Blue R; Solid Blue R; Formyl Blue B.

For shades of yellow and orange: Fast Yellow S; Acid Yellow A T; Fast Acid Yellow 3 G, T L; Indian Yellow G, R; Naphthol Yellow S; Tropaeoline G O, O O; Orange G G, extra, II, IV, R.

For red, claret, etc.: Lanafuchsine S G; S B; 6 B; Azo Orseible B B; Bordeaux B L; Brilliant Orseible C.

For violet: Azo Wood Violet, 7 R; 4 B; Acid Violet 4 R S; 6 B S.

For green: Naphthol Green B; Fast Acid Green B N; Cyanole Green B.

For brown: Combinations of various yellows, orange, green, blue, etc., are used.

For light shades, about 0.2 to 0.5 per cent. dyestuff are used, and for full shades up to 3 per cent. dyestuff, calculated on the weight of the dry skins.

For grey: Silver Grey N., which is dyed with the addition of $\frac{1}{2}$ to 1 per cent. alum without any other addition.

Dyeing with Chromate Colors.—The method of dyeing is valuable in all cases where the demands for fastness are very exacting. Most fancy shades can be produced with chromate colors, but for black it is necessary to use acid colors.

The preparation of the skins is the same as in dyeing with acid colors except that the treatment with chloride of lime may be omitted, as the hair absorbs the chromate dyestuffs well enough without this treatment. For particularly full shades, however, the treatment with chloride of lime is useful also in this case. The dyeing is carried out as follows:

The requisite quality of dyestuff is dissolved in the regular manner; and one-half as much bichromate as dye is dissolved in a separate vessel and the two solutions are mixed in the dyebath. The temperature of the liquor at the start should be 170° F., and the furs are dyed from one hour to two hours at this temperature. An addition of 1 to 3 per cent. acetic acid is then made and the skins are worked for another half hour, rinsed and hydroextracted. In order to insure good leveling on felted wool, it is advisable to use 3 or 4 per cent. monopole soap. Many shades of yellow, brown, green, blue, red, grey, etc., are obtained by using the anthracene chromate dyes, alone or in various combinations, according to the shade that is desired.

Acid and chromate colors are dissolved by pouring boiling water over them, and boiling up if necessary. The solution should then be passed through cheesecloth or a fine sieve, and any particles remaining undissolved are brought into solution by pouring some more boiling water over them.

Dyeing Furs Black with Furrol Dyes.

Preparation of the Skins.—Fur skins that are to be dyed are first subjected to the killing process, which cleans and degreases the hair; this is done in various ways as follows:

1. *Drum Killing and Soda Solution.*—The skins are soaked for three hours in a cold solution of 1 lb. of soda ash in 10 gallons of water. They are then washed, feebly acidified with acetic acid, and rinsed again.

2. *Drum Killing with Milk of Lime.*—One pound of freshly slaked lime is mixed with 10 gallons of water. The skins are treated in this cold liquor, then acidified with acetic acid and rinsed.

3. *Drum Killing with Caustic Soda Lye.*—A liquor is prepared according to the nature of the skin, with from 6 ozs. to 2½ lbs. of caustic soda lye of 77° Tw. for 10 gallons of water, and the skins, the flesh side of which has been spread with starch paste, are treated therein at ordinary temperature for about three hours. Furs with very hard hairs, such as raccoon skins, are left somewhat longer in the caustic soda lye according to requirement. They are then feebly acidified with acetic acid and rinsed.

4. *Brush Killing with Caustic Soda Lye.*—According to the quality of the skins, prepare a caustic soda lye solution of 2 to 12° Tw. and brush it onto the hairs. For some special kinds of fur, for instance fox skin, a stronger lye is applied upon the belly portion and a weaker one upon the back. The furs in this state are left lying bundled, fur side to fur side, for three to eight hours, when they are dried, brushed or cleaned. The skins are next given a drum killing as directed under 1 and 3.

Mordanting the Furs.—The dyeing operation consists of two processes, viz. the mordanting and the dyeing proper, the mordanting of the hair being required in order to effect a quicker and fuller absorption of the coloring matter in the dyebath. It is done by immersing the previously cleaned and killed skins into the solution of mordant, the time required depending upon the nature of the hair and the temperature of the bath.

The following solutions are used as mordants:

A solution of alum up to 1 lb. in 10 gallons of water.

A solution of copper sulphate up to 8 ozs. per 10 gallons of water.

A solution of bichromate of potash up to 4 ozs. per 10 gallons of water.

A solution of chrome alum up to 1 lb. per 10 gallons of water.

A solution of copperas up to 4 ozs. per 10 gallons of water.

These mordants are used without further additions, or else with the addition of 3 ozs. tartar or 2 or 3 ozs. acetic acid 30

per cent. The mordanting solution is best applied at a temperature of 68° to 77° F. For less delicate furs the solutions may be heated up to 95° F. to allow of more rapid working.

The duration of the mordanting depends upon the quality of the skins and the results desired; when working at a temperature of 68° to 77° F. six to twelve hours will as a rule be sufficient, and if a higher temperature is maintained the time may be reduced. The skins are then rinsed, and if an acid mordanting bath has been used, some soda should be added to the rinsing bath, the goods being once more well rinsed. They are then dyed.

Dyeing Black.—Black is dyed by brushing in the following manner: 3 ozs. of Furrol S and ⅓ oz. Phenylene Diamine Powder are dissolved in 1 gallon of water, and immediately before use 3 lbs. of peroxide of hydrogen are added. This solution is brushed onto the skins three times, allowing them to dry after each application.

Racoon (*Imitation Skunk*).—These skins are brush-killed with caustic soda lye of 40° Tw. or drum-killed with 1 lb. caustic soda lye of 77° Tw. per 10 gallons water.

The mordant solution consists of 1½ ozs. copper sulphate, 4½ ozs. copperas, 4 ozs. tartar in 11 gallons of water.

Dyeing is done with 4½ ozs. Furrol Grey R and 3 ozs. ammonia. The black dye is brushed on in solution prepared as above directed.

Lambskin.—These are drum-killed with 1 lb. of lime per 10 gallons of water; and mordanted with 8 ozs. copper sulphate per ten gallons of water.

Dyeing black is then done with 4½ ozs. Furrol S and ¾ oz. Phenylene Diamine Powder and twelve to fifteen times the weight of the dyestuff of hydrogen peroxide added to all the other ingredients.

Red-haired Fox is dyed black by being first brush-killed with caustic soda lye of 2 to 3° Tw., or drum-killed with 12 ozs. of caustic soda lye of 77° Tw. per 10 gallons of water.

The mordant solution is 1 lb. of chrome alum and 3 ozs. of tartar per 10 gallons of water.

The dyeing is done with 10 ozs. Furrol Gray R, ¼ oz. Phenylene Diamine Powder and 20 ozs. ammonia. Hydrogen peroxide 12 to 15 times the weight of the dyestuff. The black dye is brushed onto the skins three times, allowing them to dry after each application. This dyes the furs in imitation Alaska.

Red-haired Fox is dyed black in the following manner: The furs are brush-killed with caustic soda lye of 2 to 3° Tw., or drum-killed with 12 ozs. caustic soda lye of 77° Tw. in 10 gallons of water. The mordant is 7 ozs. of sulphate of copper and 3 ozs. of tartar in 10 gallons of water.

The dyeing is done with 4½ ozs. Furrol S and ¾ oz. Phenylene Diamine Powder and hydrogen peroxide 12 to 15 times the weight of the dyestuff, per 10 gallons of water.

Seal Rabbit (*English Imitation of Seal.*)—These furs are drum-killed with 1 lb. of lime per 10 gallons of water. The mordant is 8 ozs. copper sulphate and 3 ozs. tartar per 10 gallons of water.

The first dye bath consists of 3 ozs. Furrol Yellow Brown G, 3 ozs. ammonium chloride and ⅓ oz. ammonia. The second bath consists of 1½ ozs. Furrol S, 7 grains Phenylene Diamine Powder, 3 ozs. ammonia. Hydrogen peroxide 12 to 15 times the quantity of dyestuff. All the weights indicated are to be understood per 10 gallons of water.

Black Seal Rabbit is dyed as follows: Drum-killed with 1 lb. of lime per 10 gallons of water. Mordanted with 6 ozs. copper sulphate and 3 ozs. tartar per 10 gallons of water. Dyeing with 5 ozs. Furrol S and 1¼ ozs. Phenylene Diamine powder per 10 gallons of water; hydrogen peroxide 12 to 15 times the quantity of dyestuff.

Furrol Dyes are obtainable of the Cassella Color Company, New York.

The Tanning of Hides for Robes, Coats, Etc.

Hides of horses and cattle that are to be tanned with the hair on them and used in the manufacture of coats and robes should be soaked in fresh water before they are tanned in order

to soften them and rid them of dirt and blood and other undesirable substances adhering to them. They should be soaked long enough to become thoroughly softened, the length of time ranging from twelve to twenty-four hours.

Dry hides are more difficult to soften than salted hides. Borax, salt and formic acid are all useful in softening such hides. When borax is used from 5 to 6 lbs. of it dissolved in hot water are used in 1000 gallons of water. The effectiveness of this soak is increased by raising the temperature with steam to 90° F. The hides may be left in the soak for twelve hours, then worked upon the beam or milled in a drum in a solution of borax and water, or they may be softened in a hide mill. After the milling, they usually require further soaking, according to their condition.

When a salt soak is used, enough salt is added to the water to make it decidedly salty. The hides may be left in the brine from twelve to twenty-four hours, next drummed in salt water for thirty minutes, and then re-soaked until soft enough to be tanned.

Formic acid added to the soak water hastens the softening and, being antiseptic, prevents decay of the hides, a suitable strength being 1 or 2 lbs. in 100 gallons of water. After the soaking is completed the hides should be fleshed and all flesh and lumps of fat removed from them before they are tanned.

Alum and Salt Process.—In applying this process, the hides after they have been fleshed are placed in a fairly strong solution of alum and salt, care being taken to expose all parts of the flesh sides to the liquor, so that the hair roots may become firmly set and hair-slipping avoided. The penetration of the liquor is hastened by warming to 85° F. before the hides are put into it. The hides should be given plenty of room in the liquor so that they can be handled about once in a while and their positions changed. It is good practice to hang them upon sticks and to suspend them in the liquor. The stronger the liquor is the more quickly it tans the hides. It is always well to use twice as much salt as alum. Hides may be well struck through with a liquor made up of 6 lbs. of alum and

12 lbs. of salt for every 100 lbs. of them to be tanned. They should be left in the tanning liquor until they have become permeated with it, the length of time required to accomplish this depending upon their thickness and the strength of the liquor. They should then be soaked one-half hour in cold water and hung up to dry. When about two-thirds dry, they should be laid in piles for a few days to become uniformly soft and moist before they are dressed down. While the hides are laying in piles it is advisable to watch them and to handle them occasionally, especially in warm weather, to prevent heating, which causes more or less damage according to the degree of heat developed.

The cutting down to a light substance is done by hand. The work requires considerable skill and judgment in order that the hide may be smooth and of even thickness and free from holes. After the hides have been dressed down it is advisable to retan them. They may be placed back in the alum and salt liquor; they may be retanned with alum and salt in a drum; and they may also be retanned with chrome liquor. Retanning is also sometimes done with gambier or quebracho. One method of retanning is as follows: The hides are put into a drum together with a liquor of 6 lbs. of sulphate of alumina, 8 lbs. of salt dissolved and added to 39 gallons of water for 100 lbs. of hides.

In this liquor the goods are drummed one hour. A solution of 10 lbs. of hyposulphite of soda in 5 gallons of water is then poured into the drum and the drumming is continued thirty minutes, thus securing fixation of the tanning material upon the fibres of the hides. The goods are then rinsed in water and hung up to dry. When nearly dry they are stuffed with oil or grease; dried thoroughly and then worked out soft and clean.

By a retannage of gambier and salt the unpleasant features of alum-tanned stock are prevented, and the hides are made soft and strong. The liquor may be applied in a drum or in a vat, the process being carried along until the liquor has thoroughly permeated the hides. Then they may be left in piles for forty-eight hours, drained well and hung up to dry.

Softening and Cleaning the Stock.—For the purpose of imparting softness to the goods, oils of various kinds may be used, also combinations of tallow, soap and oil. Mineral oils are quite satisfactory. A heavy coat of oil should be applied to the flesh side; and the goods then be allowed to dry slowly and kept in the dry condition some time before they are finished. The longer they are kept in the dry condition the softer they will be when they are finally finished.

Softening and cleaning of the hides is best accomplished in revolving wheels or drums constructed especially for the purpose. The oil, grease and dirt are taken up by dry sawdust in a closed drum, and in an open or latticed drum, the sawdust, carrying the oil and grease with it, is cleaned out of the stock. The cleaning process needs to be repeated two or three times to get the goods perfectly clean and soft. Some yellow ochre added to the sawdust gives the flesh side a desirable yellow color.

Dyeing may be done with acid or Furrol dyestuffs in the same manner as furs, which has previously been described.

SECTION FOUR.

The Manufacture of Goatskin Leathers.

The first process through which goatskins are worked by the tanner is soaking, which softens them and removes the salt, dirt and blood that adhere to them. It is very important that dried and dry-salted skins should be thoroughly softened and cleansed before they are put into the lime liquors. Dried skins should be soaked separately from dry-salted stock; and to get them softened in the shortest time possible and the fibers and grain freshened and cleansed some sulphite of sodium should be added to the water and revolving drums be used as soon as they become flexible in the water.

Soaking Dried Skins.—The most efficient way to soak dry goatskins is by the use of what is known among tanners as the sulphide soak. This is prepared by adding 1 lb. of sulphide of sodium dissolved in hot water to the water in the soak vat, the quantity named being sufficient for 100 gallons of water. If the skins are heavy and very hard and dirty 2 lbs. of the material should be used. The skins are placed in the prepared soak and are left therein from one day until the next; they are then drummed in running water for a short time to further soften and cleanse them. From the drum they are placed in a clean soak, containing, like the first, 1 lb. of sulphide of sodium for each 100 gallons of water. The next day they are taken out and drummed again in running water. It is good practice to then shut the water off and to run the skins dry in the drum for fifteen minutes, after which they should be placed in clear water until the next day. Some skins require longer soaking and more drumming than others. More or less sulphide of sodium may be used as the goods seem to require, an excess doing no harm. If it is necessary to leave the skins in the last clear soak for some time before liming

them 1 lb. of carbolic acid for each 100 gallons of water should be added to prevent decomposition, the acid being washed out in running water before the process of depilation is begun.

Soaking Dry-salted Skins.—The softening of this class of stock is accomplished by soaking them in a sulphide soak over night, next drumming them in running water and then resoaking them in a second sulphide soak for twenty-four hours. These skins require very thorough drumming in running water to rid them of every trace of salt. Skins that were pulled off the animal should be cut open after they are soaked and all skins be trimmed before they are put into lime.

Softening with Bisulphite of Soda.—An efficient soak for dry stock is prepared by adding 1 lb. of bisulphite of soda to every 100 gallons of water in the vat. The skins are placed in the soak and when they have become flexible are run in a drum and next soaked again in a bisulphite soak, then washed again, and limed.

Bisulphite of soda acts as an antiseptic, preventing the growth of micro-organisms which would cause decay and loss of skin substance. It is inexpensive, hastens the softening and has no undesirable effect. The skins, softened, cleansed and trimmed, are next passed into the process of liming.

Painting the Skins with Lime and Red Arsenic.—Several days before it is used a paste of lime and red arsenic should be prepared. To 50 lbs. of lime add 4 lbs. of the arsenic and slake both together with hot water. The mixture should be stirred while it is slaking and enough hot water be added to make the mixture of the consistency of thick paint. The skins, softened, clean and drained, are spread, one at a time, upon a table or the floor and the prepared mixture is painted upon the flesh side; they are then folded down the middle lengthwise, flesh to flesh, and placed in piles in a vat until the latter is about three-fourths full. Some boards, weighted with stones, are placed upon the pile of skins and the vat is filled with water. After five or six days the skins are taken out of the vat, washed in clean water and unhaired. Some skins require from six to eight days before they can be unhaired.

This method of unhairing produces fine, smooth grain. The skins are next put into fresh lime liquor.

For 100 lbs. of stock 16 lbs. of lime and 5 or 6 lbs. of red arsenic are used, being well slaked together and poured into enough water in a paddle to cover the skins, which are put in and left in from three to seven days, being stirred by the paddles three or four hours each day. The stock is next washed in warm water and bated.

Liming.—The best results for this process are secured by using fairly fresh limes throughout and hastening the loosening of the hair by the use of red arsenic. This method of depilation is much preferred for goatskins because it produces good smooth grain, and the leather is not "pipey" or loose and spongy. Sulphide of sodium may be used in the limes but it has a tendency to make the grain coarse and harsh. If used at all, it is best to employ it in the first limes, which are fairly mellow, and then to finish the liming in fresh white limes. 5 or 6 lbs. of red arsenic are generally used with 100 lbs. of lime. The limes should be fairly sharp so that the skins will be plumped. A good rule to follow is to use mellow limes at first, working the skins into fresh limes and leaving them in the latter two or three days to finish. Newly made lime liquor should contain some old lime to tone down its harsh effect upon the skins. After the hair has become loosened it is advisable to leave the stock in the lime a day or two longer to insure softness in the finished leather.

A good liming process is carried out in the following manner: A vat six feet deep should be filled with two or three feet of used lime liquor and two feet of cold water. Into a tub one-eighth of the weight of the skins of lime and one per cent. of red arsenic are placed and slaked with 10 or 12 pailfuls of hot water, 5 pailfuls of cold water being next added and the solution poured into the vat. The liquor is then plunged thoroughly and the skins are thrown in, and by means of the paddles stirred about in the lime. If the hair begins to loosen on the third day one-fifth of the weight of the skins of lime should be added; if the hair is not loosened more lime than

one-fifth the weight of the skins should be used. No exact rule can be given and the man in charge of the work must be able to determine how much lime and arsenic to add to the liquor. Some skins require more lime than others. When the hair can be easily removed the skins are taken out of the lime and unhaired.

Good results are secured by working goatskins through a series of sulphide limes, old plumping limes to which 2 ozs. of sulphide of sodium per skin has been added, being used. From eight to ten days are required. The goods are then put into fresh or plumping limes for two or three days, next unhaired and washed. Sulphide of sodium may be mixed with lime and painted upon the flesh-side of the skins the same as upon skeepskins, and after the hair has been removed, the skins are limed for a few days. The most rapid process of depilation consists of immersing the goods in a strong solution of sulphide of sodium, which dissolves the hair and swells the skins; but this process cannot be recommended for any but the cheapest grade of skins.

The next process is bating and drenching. On removing the skins from the lime they are thrown into water at 85° F., for one-half hour, then unhaired and washed.

Bating.—The thorough removal of the lime is accomplished in a clean and efficient manner by using oropon, a commercial bacterial bate, 8 ozs. of it for 100 lbs. of stock being dissolved in hot water and poured into water at 100° F. The skins are thrown in, paddled from time to time, and left in the liquor over night. The next morning they are in a soft and open condition and free from lime.

The process commonly called bating or puering frees the skins from lime and alkaline sulphides acquired during the previous process of liming, and makes them soft and clean and in the right condition to be pickled and tanned. To accomplish the results of this process hen and pigeon droppings and dog dung have for many years been used; and although the use of these materials is unpleasant, they produce results that cannot be obtained from the use of others, and

they continue to be employed by many tanners. Goatskins are frequently puered with a mixture of chicken droppings and dog dung, the latter also being often used alone.

To prepare the material put it to soak in hot water two or three days before it is to be used. Mash it well; stir it occasionally and strain it through a wire strainer to get rid of pebbles, feathers, etc., this, however, being not always necessary. The skins should first be washed in warm water to remove surface lime, then be placed in a used bate liquor that has been warmed to 80° F., and left in the same for twelve hours. From such liquor they are placed in a fresh bate warmed to 85° F., and paddled in the same for several hours or until they are soft and silky. They are next fleshed, scudded, rinsed or drenched and pickled or tanned. Goatskins can be delimed also in any of the processes described for sheepskins and calfskins. The use of oropon can be recommended above bran or acids, since it gives the smooth, fine grain that is so much desired on goatskin leather.

Drenching.—The skins, after they have been bated, are given a drench of boric (boracic) acid to remove the last trace of lime and to make the grain clear and smooth. A small quantity of the acid is dissolved in water of 85° F.; the skins are paddled in the solution a half hour and then pickled and tanned.

The following process is said to be excellent for goatskins for chrome tanning. Dissolve 20 lbs. of sal-ammoniac and 70 lbs. of salt in 700 gallons of water at 95° F., for 50 dozen skins. Paddle the skins in this liquor for two hours, then leave them in over night. Sal-ammoniac and salt in combination produce ammonia and act upon the goods in the same manner as a bate or puer, having however the advantage that the workman can control this process while he cannot always control the old-time puering. The next morning the skins are transferred to a drench and pickle in a paddle wheel containing 10 lbs. of formic acid and 8 lbs. of salt; temperature 85° F. After an hour in this liquor the skins are in condition to be tanned. The last drench and pickle removes all the

lime and strengthens the fibers so they will stand the corrosive action of the chemicals and acids used in chrome tannage.

Ammonium butyrate, the ammonium salt of butyric acid, is one of the newer chemical products used in the process of deliming and bating limed skins, about 2 lbs. of it being used for 100 lbs. of pelt in water heated to 85° F. The skins, after they have been unhaired, are paddled in the liquor a quarter of an hour each hour for three or four hours; they are then bated in the regular manner, less bate being used, however, than would be, had the goods not been given the preliminary deliming. The next step in the manufacture of goatskin leather is pickling with acid and salt.

Pickling with Sulphuric Acid and Salt.—To 40 gallons of water 40 lbs. of salt and 5 lbs. of sulphuric acid are added; this forms a stock pickle, 12 gallons of this liquor being used for 100 lbs. of skins. The pickling is accomplished most rapidly in a drum, the skins being run in the liquor at least fifteen minutes, then allowed to press and drain over horses for several hours or until the next day.

Another good formula calls for 2 lbs. of sulphuric acid, 15 lbs. of salt and 15 gallons of water for 100 lbs. of skins. The drum containing the skins is started and after it has turned a few times the solution of acid and salt is poured in and the drumming is continued from fifteen to thirty minutes. Either of these processes produces good results and there is no guesswork about the quantity of acid and salt to use, and therefore no uncertainty.

Pickling with Formic Acid and Salt.—The formula for this pickle is 10 lbs. of the acid, 20 lbs. of salt and 15 gallons of water for 100 lbs. of skins. The process is carried out in the same manner as the sulphuric acid process. An excellent way to pickle the skins, no matter which acid is used, is to put them into the drum together with three-fourths of the water that is needed. In the remaining fourth of the water the salt is dissolved and the acid added thereto. The drum is started and the acid and salt solution poured in through the trunnion, and the drum allowed to run thirty minutes.

Pickling with Sulphate of Alumina and Salt.—This is an excellent process of pickling since it plumps the skins and prepares them for chrome tanning, 4 lbs. of sulphate of alumina and 6 lbs. of salt in 12 gallons of water being used for 100 lbs. of skins. The stock is treated with this solution in a drum for thirty minutes and then either tanned at once or placed smoothly over horses until the next day. The sulphate of alumina does not remain in the skins and forms no part of the tanning process.

Two-Bath Processes of Chrome Tanning.

1. For each 100 lbs. of pickled skins to be tanned use bichromate of soda, 6 lbs.; muriatic acid, 3 lbs.; salt, 4 lbs.; water 15 gallons. The liquor is prepared by adding the salt to the water, next the bichromate of soda dissolved in hot water, and the acid is then slowly stirred in. A drum is used, and the skins having been thrown in, is set in motion. The prepared liquor is poured into the drum through the hollow axle and the skins are turned for from one to two hours. They are then taken out of the drum and placed smoothly over horses to allow for draining and for the chrome to become fixed in the fibers. The process is completed the next morning. The skins are dipped, one at a time into a 10 per cent. solution of bisulphite of soda and then thrown into a drum.

The second bath consists of hyposulphite of soda, 12 lbs.; muriatic acid, 6 lbs.; salt, 3 lbs.; water, 15 gallons. The hyposulphite of soda is dissolved in boiling water and added to the water in a tub. The salt and acid are then added, and the skins are drummed in the liquor for 1½ hours or until they have assumed a light blue color throughout. This completes the tanning. Tne leather is again placed over horses to press and drain from twelve to twenty-four hours before it is washed and neutralized.

2. In this process of chrome tanning sulphuric acid is used in the first bath and bisulphite of soda in the second. The first bath consists of bichromate of soda, 6 lbs.; sulphuric acid, 2 lbs.; salt, 4 lbs.; water, 15 gallons. Prepare and use the same

as No. 1. The second part of the process consists of a solution of bisulphite of soda, 6 lbs.; water 15 gallons. The skins are drummed in this liquor for from one to two hours; they are then placed over horses for twenty-four hours to allow hydration to take place, after which they are washed and neutralized. Either bichromate of soda or of potash may be used in the first bath. Chromic acid may be used in the first bath in place of potash or soda and acid. From 4 to 5 lbs. are used for 100 lbs. of skins without acid, but the quantity of salt should be increased somewhat, especially when the skins were not pickled. The tanning can be accomplished in a very satisfactory manner by applying the first bath in a drum, the second in a paddle reel.

3. Goatskins may also be tanned into chrome leather in the following manner: For each 100 lbs. of skins the first bath consists of bichromate of soda, 5 lbs.; muriatic acid 5 lbs.; sulphate of alumina, 2 lbs.; salt, 5 lbs.; water 15 gallons. After the skins have been drummed in this solution for 1½ hours they are placed in the second bath in a paddle, or run in it in a drum. This bath is a solution of hyposulphite of soda, 14 lbs.; muriatic acid, 5 lbs.; water, sufficient to process nicely. It is good practice to put the skins into the hypo solution and then to add the acid slowly whilst constantly stirring.

Skins that have not been pickled can be tanned in the same manner as acid-pickled stock. Any two-bath process may be carried out in a paddle vat as well as in a drum, the same quantities of chemicals and acid being used as in drum tanning; but more water is required and the process takes more time.

4. The process described below, somewhat different from the foregoing one, also produces excellent chrome leather. The skins, after having been bated and washed, are thrown into a drum, together with a solution of salt, 10 lbs.; in water, 15 gallons, and run in the same ten minutes, 2 lbs. of muriatic acid being next added to a pailful of water and poured into the drum, and the drumming is continued fifteen minutes.

This accomplishes the pickling of the stock. The next step is the addition of the chrome liquor to the contents of the drum, the pickling solution having been previously drained out. Bichromate of potash, 2 lbs.; water, 12 gallons. After this has been in the drum twenty minutes, bichromate of potash, 4 lbs., salt, 3 lbs., water, 6 gallons, are poured into the drum and the skins run in the liquor for two hours. They are then horsed up over night, struck out the next morning and passed through the hypo dip. This consists of hyposulphite of soda, 4 lbs.; water 15 gallons, for 100 lbs. of skins. After having been dipped, one at a time, into this solution, they are paddled in the second bath, which consists of hyposulphite of soda, 10 lbs.; water, 20 gallons; muriatic acid, 5 lbs. As soon as the liquor turns milky the skins are thrown in, processed a few hours, left in overnight, drained twenty-four hours, and then washed and neutralized.

Tanning in a Paddle Vat.—Where the skins are tanned in a paddle vat the procedure is as follows: The first bath consists of 6 per cent. of the weight of the skins of bichromate of potash or bichromate of soda and 3 per cent. of muriatic acid 20° Bé. The chrome is dissolved in boiling water and added to the water in the reel, about 65 gallons for 100 lbs. of skins. It is immaterial whether bichromate of potash or of soda is used. The skins are paddled in the liquor for several hours and left in over night. The next morning they are taken out of the liquor, struck out and dipped in a solution of hyposulphite of soda to which a little muriatic acid has been added. After dipping, the stock is thrown over a horse and allowed to remain for a short time before it is placed in the second bath. This bath is made of water, hyposulphite of soda and muriatic acid, the proportions being 18 lbs. of the hypo and 5 lbs. of the acid in 65 gallons of water for 100 lbs. of skins. The hypo is dissolved and added to the water; the acid is then poured in and the stock thrown in as quickly as possible. Some tanners do not add all the acid at once, two-thirds of the quantity used being first added, and the rest after the skins have been thrown in. When the yellow color

of the stock has been turned to light blue throughout the thickest skins, the process is completed. The skins are taken out, placed over horses for twenty-four hours, and are then washed and neutralized. Both bichromate of potash and hyposulphite of soda are used in excess but without injury to the stock, a few pounds more or less for a large pack of skins making no difference in the quality of the leather.

One-bath process.—The pickled skins are thrown into the drum together with 8 gallons of water and 6 lbs. of salt for each 100 lbs. of skins, and the drum is run fifteen minutes. 6 lbs. of Tanolin are dissolved in 2 gallons of boiling water. When the solution has cooled, one-third of it is added to the contents of the drum and the skins run for thirty minutes; then another one-third is added and the drum is run another half-hour; finally the last portion is poured in and the drumming is continued for one hour. 8 ozs. of bicarbonate of soda are dissolved in a little water aud the solution is poured into the drum, which is run two hours longer; then 6 ozs. more of the soda for 100 lbs. of skins are added to the liquor in the drum, and the stock is run until it is fully tanned. The completion of the tannage is determined by boiling a piece of the neck of the thickest skin. If it remains soft and does not curl or harden the leather is fully tanned. The tanned skins are next horsed up 48 hours to allow for complete fixation of the chromium hydroxide; they are then washed and neutralized.

Tanning with Sulphate of Alumina, Sal Soda and Chrome Liquor.—Pickled goatskins may be tanned in the following manner: Weigh them and for each 100 lbs. in the pack prepare two solutions. Boil 3 lbs. of sulphate of alumina in 5 gallons of water. In another vessel boil 3 lbs. of sal soda in 5 gallons of water. Pour the solution of sal soda slowly and whilst constantly stirring into the solution of sulphate of alumina, allowing intervals for the effervescence to subside. The two solutions form a white liquor. This should be allowed to cool before it is used, or enough cold water should be added to reduce the temperature to 85° F.

Throw the skins into the drum together with 10 lbs. of salt and 5 gallons of water and let the drum run ten minutes; then pour into the drum the alumina-soda liquor and run the skins in it thirty minutes. Dissolve 6 lbs. of Tanolin in 3 gallons of boiling water and pour the solution into the drum in portions of 1 gallon at a time at intervals of one-half hour, and after the last portion is in, drum the skins for one hour. To complete the tanning add 1 lb. of salts of tartar dissolved in 1 gallon of hot water, and let the drum run one hour; then pour into the drum enough cold water to make the liquor cover the skins and let them remain in it until the next morning. The tanned leather, after draining twenty-four hours, is washed, neutralized and shaved.

Good leather is also made by drumming the skins after they have been bated and drenched in a solution of 3 lbs. of sulphate of alumina and 8 lbs. of salt in 8 gallons of water. At the end of thirty minutes drumming one-bath chrome liquor is poured into the drum in portions of 1 gallon at a time until 3 or 4 gallons have been added to the contents of the drum. Three or four hours drumming completes the tanning, and the leather is then handled in the usual manner.

Process of Alum and Chrome Tanning.—Skins tanned by the following process work out into the leather that possesses the qualities of both alum and chrome leather. In appearance, plumpness, fine grain, softness and feel the leather resembles alum leather, and in softness and durability chrome leather. The first step of the process consists of tawing the skins in a solution of sulphate of alumina and salt. In the second step the sulphate of alumina is fixed upon the fibers of the skins by means of a solution of hyposulphite of soda, and after this has been accomplished, another solution of sulphate of alumina and salt is given to the skins, by means of which they are plumped and the thinness that follows the use of hyphosulphite of soda is overcome. By these operations the skins are thoroughly alum-tawed, and, if desired, may be finished without further tanning. To complete the process and produce chrome leather, the skins after the final application of alu-

mina and salt and chrome are tanned. In practice the process is as follows: The skins after drenching and washing, are drained and weighed. For every 100 lbs. of them a solution is prepared consisting of 3 lbs. of sulphate of alumina and 6 lbs. of salt in 3 gallons of water, boiled and allowed to cool. The skins are drummed in this solution twenty minutes. Then 10 lbs. of hyposulphite of soda are dissolved in 3 gallons of water and this liquor is poured into the drum and the drumming continued fifteen minutes. To finish the first part of the process, a third solution is prepared by dissolving in 3 gallons of water 2 lbs. of sulphate of alumina and 3 lbs. of salt. This solution is added to the contents of the drum and the drum run thirty minutes.

The skins, now plump and full, are next rinsed off in clear water, drained several hours, and then given the chrome liquor, which is used without the addition of water or acid. From 3 to 6 gallons of the concentrated chrome liquor are required for 100 lbs. of skins. The chrome liquor is prepared as follows: 5 or 6 lbs. of chrome alum are dissolved in 5 gallons of water without the aid of heat. To this solution are added from 2½ to 3 lbs. of sodium sulphate and from 12 ozs. to 1 lb. of potassium or sodium acetate, or its chemical equivalent. In a liquor thus prepared the skins are drummed one hour or until they are chrome-tanned. They are then allowed to drain twenty-four hours, washed in the usual manner, shaved and colored. For thick, heavy skins the quantity of chrome liquor used may be increased to 6 or 7 gallons for 100 lbs. of stock. In this process no free acids whatever are used. Free acid in the solution, added as an element, that is, other than as produced by the decomposition of the chemicals, will retard, if not prevent, the reaction necessary to produce leather. For this reason the skins must be entirely free from acid and perfectly neutral when the process is begun.

After the tanning is completed, the skins should be left in the liquor some hours, then thrown over horses to drain for twenty-four hours to allow for complete tannage of the fibers. The leather is then washed in warm borax water and next in

clean water, then shaved, colored and finished. This process is patented by George W. Adler, Philadelphia, Pa.

A New Two-Bath Process of Chrome Tanning.—This process is similar in its manipulations to the regular two-bath process, as will be seen by the description of it. It can be executed in two-bath or in one-bath.

The directions for one-bath are as follows; For 100 lbs. of skins use 4 lbs. of bichromate of potash and 3 lbs. of muriatic acid, 20° Bé., water sufficient for the pack of skins to be processed properly. When the skins are thoroughly impregnated with this liquor and seasoned, add to the bath, while the goods are in motion, 20 per cent. of the weight of the skins of S. Z. solution and 35 per cent. of S. K. solution, these two solutions being mixed before they are added to the bath. Then add, the skins being in motion, 5 per cent. of sulphuric acid, 66° Bé. Before adding the acid, mix it with about thirty times or more its weight of water. Then add this mixture through a lead-lined wooden funnel, long enough to reach to the bottom of the vat, and placed at one corner of it, while the goods are in motion.

After about one and a half days the skins are done. No damage will result to them should they remain a longer time in the liquor. When done, wash and finish them. This tannage produces a finer grain, less contracted and besides sulphur as in the hypo process, is not present. Skins by this tannage are pre-eminent for making enamel or patent-finish leather.

The proportions for making the solutions are: For S. Z. solution use 80 lbs. of nitrate of soda and 84 lbs. of hot water.

For S. K. solution use 48 lbs. of fresh chloride of lime, 48 lbs. of soda ash and 384 lbs. of hot water. Dissolve the soda ash in hot water. When all is dissolved, add through a sieve the chloride of lime, keeping the liquor always well stirred. When all the lime is stirred in, leave the liquor at rest until it becomes clear, say two days, then draw off the clear liquor for use as above, and throw the sediment away. Both liquors S. Z and S. K. may be kept in one vessel—carboy, vat or hogshead—provided the proportions are kept up, and when

wanted the proper quantity is taken out. A wooden tank or hogshead should be used for making the solution.

In place of solutions S. Z. and S. K., as above, peroxide of sodium with sulphuric acid may be used. To each 100 gallons of water in the vat add 5 lbs. and 5 ozs. of sulphuric acid, 62° Bé.; stir well; then add, by sifting in, 4 lbs. of peroxide of sodium in small quantities, while stirring well; use hand-warm water for the bath. When this bath is ready put into it the previously chromed skins, and paddle them until they are tanned.

Neutralizing and Washing the Tanned Leather.—The object of these processes is to remove the acid and salts from the leather and make it perfectly neutral for coloring, fat-liquoring and finishing. Chrome-tanned leather is unique in one respect; namely, it will stand without injury any amount of washing with water. The latter alone, however, removes the acid so slowly that it is a common practice for tanners to add a small quantity of alkali to it to expedite the work.

In all cases of chrome tanning, whether by the two-bath or the one-bath method, the leather should press and drain from twelve to twenty-four hours to allow the chromium hydroxide to become dehydrated and fixed in the fibers. It is then in the right condition to be washed and neutralized.

The use of sodium bicarbonate for neutralizing the leather is recommended by the writer. It destroys the free acid, helps to fix the chrome, is inexpensive, and does no damage to the leather. One pound of the chemical is used for 100 lbs. of leather in enough water to wash nicely in a drum. The leather is washed one-half hour, when the plugs are pulled out and the leather is washed a half hour longer with running water. The skins are then struck out and shaved.

Neutralizing with Borax.—A common method of removing the acid from the leather involves the use of borax, the quantity of it required varying with the amount of acid present in the leather; but it should be borne in mind that only so much of it should be used as to have the leather still to show a very weak acid reaction. As a rule from 1 to 2 per

cent. borax calculated on the shaver's weight of the leather, proves sufficient. The borax is dissolved in hot water and added to the water in which the leather is washed. The leather is drummed in such water for forty minutes at a temperature of 80° F. After it has been thus neutralized it is recommended to wash it well with running water.

Insufficient neutralization of the leather, which is indicated by blue litmus paper turning red when pressed against the leather in the cut, may cause various difficulties. It may especially cause an unsatisfactory absorption of the fat-liquor, or lead to the dyestuff being fixed too superficially or precipitated in the bath; besides leather insufficiently neutralized has a tendency to spew. Some tanners shave their leather before they neutralize it; others neutralize before shaving. In some tanneries the leather is first washed in warm running water. The borax is then dissolved in a sufficient volume of water to allow the leather to move freely in the drum and the drumming in such water, preferably warm, should continue thirty minutes. The leather is then rinsed well in warm water. Where the skins are shaved before they are neutralized and washed, and are fat-liquored or dyed immediately afterwards, the last rinsing should be in hot water at 125° F., thus raising the temperature of the skins in anticipation of the coloring or fat-liquoring process that is to follow.

Notes and Suggestions.—It is not always practicable for the tanner to follow set formulas and rules in chrome tanning on account of the differences in the raw stock he uses. The skins should be given what they require and no more. In the second or hypo-bath it is best to add only about two-thirds of the acid to the hypo solution, then as the process proceeds to add more acid until the prescribed quantity bas been used. The skins should come from the second bath as nearly neutral as possible and the process be so conducted as to attain this result. More chemicals than are necessary are usually used and more than the skins take up. Experience has proved this to be good practice, especially where a paddle-vat is used. The liquors are never fully exhausted when the

skins are taken out, yet it is best to run them out and to prepare new liquors for the next pack of skins. It is best to let the goods drain over night from the first bath and to strike them out before putting them into the second bath. When a two-bath process is used there is no danger of contracted grain and the leather works out soft and silky and to the greatest possible area of measurement. Skins pickled with sulphate of alumina and salt can be tanned without being depickled; but if it is considered advisable to remove acid pickle, it can be done in a bath of whiting and salt, the skins being then washed in warm salt water and tanned.

It is feasible in using the two-bath process of chrome tanning, to pickle the skins with muriatic acid and salt and then to give them the first bath, which is made of bichromate of potash or of soda and salt without acid. When this is done the acid pickle serves to liberate the chromic acid in the bath. Whenever pickled skins are being tanned considerable salt should be added to the first liquor. The first or chrome bath is given most advantageously in a drum; the second or reducing bath may be applied in either a drum or a paddle-vat. There should always be sufficient water used to give proper working conditions. The ratio of potash or soda to the weight of the skins may vary considerably without affecting the result.

Some tanners put the skins into the solution of hyposulphite of soda and then add the acid rather slowly. Others add all the acid to the hypo-bath and as soon as the liquor turns milky throw the skins in as rapidly as possible. It is the opinion of the writer that the latter method is the better of the two. When the tannage seems to be finished, it is advisable to leave the leather in the liquor some hours or over night to insure complete reduction and deposition of the basic chrome salt. The quantity of hyposulphite of soda may range from 10 to 20 lbs. for 100 lbs. of skins, but it is the usual rule to use more than the stock requires as an excess does no harm it being rather beneficial to the quality of the leather. It is advisable to dip the chromed skins into a fairly strong solution of hypo before

putting them into the second bath. This "dip" may consist of 5 lbs. of hypo in 10 gallons of water, or a 10 per cent. solution of bisulphite of soda. This prevents "bleeding" of the chrome into the second bath, and drawn grain. Hyposulphite of soda is used with acid in the second liquor, bisulphite of soda without acid.

The Difference Between One-Bath and Two-Bath Chrome-Tanned Leathers.—One of the main causes of the differences between leather tanned by the one-bath method and leather tanned by the two-bath method, says the *Shoe and Leather Reporter*, is to be found in the fact that free sulphur is deposited upon the fibers of the skins by the two-bath and not in the one-bath process. In both processes the chrome salt which actually converts the pelt into leather is a basic one, so that the main difference is not to be sought in the nature of the actual tannage but rather in some of the side reactions. One of the side reactions which takes place in the two-bath process but not in the single-bath process, is the liberation of sulphur when hyposulphite of soda and muriatic acid are used in the second bath. It is customary to add the acid to the solution of hypo until a slight turbidity or milkiness appears before introducing the skins. The sulphur dioxide takes part in the reduction of the chromic acid in the skins and the free sulphur is precipitated both in the surrounding liquor and in the fibers of the goods. It is the free sulphur which produces the turbidity of the liquor. This sulphur produces softness, gives the leather its white appearance and acts as a kind of a lubricant to the fibers so that they slip over one another more readily, producing the effect of softness or mellowness.

Free sulphur can be incorporated into leather tanned by the one-bath process by a special operation proposed by Eitner, the German leather chemist. This operation consists of treating the skins before tanning with hyposulphite of soda and acid. The goods are treated first with one, and then with the other, 100 lbs. of pelt being drummed for forty-five minutes with 100 gallons of water, 20 lbs. of salt and 4 lbs. of muriatic acid. The goods, after drumming, are allowed to drain

and are again drummed for six hours with 20 per cent. hypo. The same reaction takes place as that described for the two-bath process, the acid liberating the sulphur from the hypo, but in this case the precipitation of the sulphur takes place entirely in and on the fibers. Skins treated by this process and then tanned by the one-bath method have most of the properties of two-bath-tanned leather.

A simple test to determine whether leather has been tanned by the one-bath or the two-bath process consists in determining whether there is any free sulphur in it. A silver coin is cleaned and moistened and then wrapped round with a piece of the leather and put in a warm place. In the case of heavy leather a slit should be made with a knife and the coin placed in it. After an hour or so, if there is free sulphur in the leather, the coin will be found to be darkened or blackened by the effect of the sulphur upon the silver.

The Process of Fat-liquoring.

Fat-liquoring is a process of much importance in the finishing of chrome-tanned leather. No matter how well tanned the skins may be, if they are not properly fat-liquored they dry out rather stiff and lack that full, well-nourished feel that is so essential. The fat-liquor imparts to the leather the necessary fullness and softness. The process consists in treating the leather in a drum with a hot emulsion of soap, oil and other ingredients, which is entirely absorbed by the leather. When not sufficiently fat-liquored the skins, when finished lack softness and fullness; if given too much grease they work out too soft and cannot be finished satisfactorily. The fat-liquor should be a perfect emulsion; if it is not, the grain is apt to have a greasy feel and the colors a patchy appearance. Neatsfoot, olive, castor and sulphonated oils are generally considered the most suitable oils for fat-liquoring light leather, eggyolk and soap being usually combined with them. There are also several prepared fat-liquors and oils obtainable that are of much value. Commercial fat-liquors are carefully prepared, blended and aged, and containing no excess of alkali, they

produce excellent results on both chrome and vegetable tanned leather. Sulphonated oils require merely to be dissolved in hot water to be ready for use. The best way to use such oils is to combine them with some rich oil or grease, such as neatsfoot oil or moellon degras. The sulphonated oil so used acts as the carrier and emulsifier of the other oils and greases.

Previous to being fat-liquored the leather should be pressed or struck out to rid it of the surplus water which would retard the penetration of the fat-liquor. A suitable drum is heated with live steam to a temperature of about 140° F. Whatever water there may be in it is drained out and the skins are thrown in and drummed for five minutes to warm them. The hot fat-liquor is then poured into the drum through the hollow axle and the skins are drummed in it for thirty minutes, being then dipped into hot water and placed smoothly over horses and covered up for several hours so that the grease may combine with the fibers. It is the custom at the present time to fat-liquor chrome leathers before coloring them.

Receipts for Fat-liquors.—1. Quantities for one dozen skins: Castile soap, 4 ozs.; eggyolk, 1 pint; olive oil, ½ pint; water, 3 gallons. Chip the soap into the water and boil until it is dissolved. Add the oil and stir, and boil thoroughly for ten minutes. Cool the liquor to 95° F., and add the eggyolk, stirring thoroughly. Use at 100° F. For glove leather 1 pint of flour should be made into a paste with water and added to the fat-liquor.

2. For 100 lbs. of leather: Castile soap, 1½ lbs.: neatsfoot oil, 1½ pints; eggyolk, ½ lb. Dissolve the soap in a pailful of hot water; add the oil and eggyolk and mix well: then add water to make 12 gallons, and bring up to boiling point.

3. For 100 lbs. of leather: Dissolve 1 lb. olive soap in a pailful of hot water. Add 1½ pints castor oil and ½ lb. eggyolk and mix well. Add water to make 12 gallons, and bring to boiling point.

4. To make 50 gallons of fat-liquor use the following materials: Palermo Fig soap, 10 lbs.; neatsfoot or cod oil, 4 gallons; eggyolk, 10 lbs.; salt, 2 lbs. Put the soap into a

clean barrel together with a few gallons of water. Turn on steam and boil, and stir the soap until it is dissolved. Take the oil, which should be the best grade obtainable, and cut it by stirring into it a few ounces of borax or of sal soda dissolved in a little hot water, and add it to the dissolved soap, stirring the mixture for several minutes. Then run into the barrel enough water to make 50 gallons of liquor; finally stir in the eggyolk and salt. Use at a temperature not higher than 90° F. 2 gallons are sufficient for one dozen skins. Care should always be taken to cool the soap and oil before adding the eggyolk, as the latter coagulates if the liquor is warmer than 80° F.

5. The use of sulphonated oil in conjunction with neatsfoot oil is especially recommended by the writer. Many of the difficulties of the fat-liquoring process can be overcome by using a fat-liquor made as follows: 2½ lbs. of neatsfoot oil are heated to 160° F., together with ½ oz. of carbonate of potash. Then add 12 ozs. of potash soap dissolved in boiling water. Stir well; shut off steam and add ¾ lbs. of sulphonated oil. This forms an emulsion that mixes readily with water. Use about 3 per cent. of this mixture calculated on the weight of the leather after shaving. Neatsfoot oil and sulphonated oil mixed together and a little ammonia added also makes a good fat-liquor. Acid fat-liquors are safe to use and economical. The sulphonated oil emulsifies the neatsfoot oil and carries it into the leather.

6. The following is an excellent fat-liquor for heavy skins, black or colored: Castile soap, 8 ozs.; olive oil, 2 lbs.; moellon degras, 2 lbs.; salts of tartar, 3 ozs.

Any good fat-liquor soap can be used instead of castile. This liquor is prepared in the same manner as No. 4, the moellon degras being added after the oil and soap have been boiled and stirred. The quantities of material given are for 12 gallons of fat-liquor, which is sufficient for 100 lbs. of leather.

7. For dull-finished goatskins the following fat-liquor is recommended: Soap, 1 lb.; neatsfoot or olive oil, 2 lbs;

moellon degras, 2 lbs.; caustic soda, 1 oz. Boil the soap in a few gallons of water; then add the oil and boil ten minutes. Turn off the steam and add the degras to the mixture, stirring very thoroughly. Finally add the caustic soda dissolved in 2 quarts of water, and add sufficient water to make 12 gallons of liquor. Use at 125° F., and drum the leather in it for thirty minutes. Then let it drain over horses for twelve hours before striking it out and oiling the grain. Eggyolk may be used in place of moellon degras.

8. Chrome-tanned goatskins can be nicely fat-liquored with eggyolk and neatsfoot oil. The oil should be thoroughly beaten into the eggyolk and warm water added. For 200 lbs. of leather use 15 lbs. of salted eggyolk and 1½ lbs. of neatsfoot oil. Mix together; then add water to make 20 gallons in all; and use at 100° F.

9. A fat-liquor made of neatsfoot oil, 2½ lbs.; soap, 1 lb.; eggyolk, 1 lb.; for 100 lbs. of shaved leather produces excellent results.

10. Soap, 3 lbs.; neatsfoot oil, 3 lbs.; and five eggyolks also makes a good fat-liquor for light leather. Numbers 9 and 10 are prepared and used in the usual manner.

In any process of fat-liquoring it is advisable, after the leather has been drummed in the liquor thirty or forty minutes, to drain the water that remains out of the drum and to run the leather dry with the door off to cool and distribute the fat-liquor.

11. A high grade of sulphonated oil is one of the best materials that can be used in fat-liquoring chrome leather, black or colored. For instance, a liquor made according to the following instructions has been used in practice with satisfactory results. Take 1⅓ lbs. of neatsfoot oil and heat it to 160° F., together with ½ lb. of potash soap dissolved in a little hot water. Mix thoroughly; allow the oil to cool and then add 1⅓ lbs. of sulphonated oil such as Kromoline V. T., and use about 3 lbs. of the mixture for 100 lbs. of leather, preferably before dyeing. Where the leather has not been fully neutralized after tanning, 8 ozs. of ammonia for 100 lbs. of leather should be added to the fat-liquor.

12. The following composition represents a fat-liquor that may be used upon any kind of chrome leather: 500 parts by weight olive oil soap; 800 parts water; 25 parts borax; 250 parts neatsfoot oil; 125 parts eggyolk. From 2 to 8 pounds are required for every 100 lbs. of leather according to its nature and the degree of softness desired.

Notes.—Neatsfoot oil should not contain any solid fatty substance that is likely to separate at a low temperature and thus cause exudation. Nor should there be any solid fatty acids in the soap. A small quantity of borax or sal soda is often added to obtain a finer emulsion; and the use of castor oil, Turkey red oil or castor oil soap is advisable when very pliable leather is wanted. Fat-liquor should penetrate the leather easily and should not contain any ingredient likely to cause exudation or spewing. A greasy or sticky feel of the leather after fat-liquoring indicates insufficient neutralization or the presence of lime. Where leather is to be colored after it is fat-liquored it should immediately after completion of that process be dipped into clean, hot water so as to remove surface oil. This rinsing in hot water clears the grain, and the mordant and dye "take hold" more readily.

13. An excellent fat-liquor for colored goatskins consists of ½ lb. of either castor oil soap or olive oil soap and ¾ lb. of castor oil for 100 lbs. of leather. Boil the soap; add the oil and after stirring and boiling, apply in the usual manner.

14. Formula for one dozen skins: From 1 pint to 1 quart of eggyolk (according to size and thickness of the skins) and from ½ pint to 1 pint olive oil. Beat thoroughly together, add warm water and drum the leather in the mixture in the customary manner.

The Dyeing of Chrome-tanned Goatskins.

Dyeing with Acid Colors.—The leather neutralized and shaved, is fat-liquored and then rinsed in water at 120° F. Twelve gallons of water heated to 125° F. are used in preparing the dye bath for 100 lbs. of leather. The leather and the hot water are put into the drum. The solution of dyestuff

without any addition of acid is then poured into the drum while it is rotating and the leather is drummed twenty minutes. If particular value is attached to good penetration there should be added to the dyestuff 1 oz. or more of ammonia; but this addition is effective only where the skins have been completely neutralized.

At the expiration of the twenty minutes the dye bath is acidified by the addition of formic or sulphuric acid, preferably the first-named. Enough acid should be used to neutralize the ammonia and in addition 2 parts by weight of formic acid or 1 part by weight of sulphuric acid for every 4 parts by weight of dyestuff are necessary. After the color bath has been thus acidified the leather should be drummed ten minutes to allow for the dyestuff to become fixed.

The addition of a quantity of sumac or gambier liquor to the dye bath after it has been acidulated improves the feel and fulness of the leather and makes it later on easier to obtain a good glazed finish.

In order to remove any excess of acid that may be present in the leather after it has been colored, there should be added to the water in which the skins are rinsed a solution of 4 ozs. of acetate of soda crystals for each 100 lbs. of leather.

Very full shades are obtained by first coloring with acid dyes and then topping slightly with basic color. This is done by adding a solution of some basic color, 2 ozs. or more dyestuff for 100 lbs. of leather, as soon as by the addition of acid, all the acid color has been exhausted from the dyebath. If this cannot be effected completely the topping may be carried out in a fresh bath, in which case no further rinsing is necessary.

The temperature of the dye-bath should be kept as high as possible during the process and should not be lower than 120° F. It is advisable, to pass the skins before throwing them into the drum, through hot water or to drum them in it in order to warm them thoroughly. The sumac liquor that is used in connection with the solution of dyestuff is made by steeping from 12 to 16 lbs. of sumac leaves, sumac powder or

sumac extract in 10 gallons of hot water, 2 gallons of the decoction being used for 100 lbs. of skins. Sumac may, however, be partly or wholly substituted by gambier, that is to say, the liquor may be made of equal parts sumac and gambier or gambier may be used alone.

A practical method of coloring chrome goatskins with acid dyes is carried out as follows: The leather, neutralized and shaved and fat-liquored, is weighed and thrown into the drum together with a few gallons of hot water. For 100 lbs. of leather 7 or 8 gallons of dyestuff solution and 2 gallons of sumac liquor are run into the drum and the leather is drummed from twenty to thirty minutes. A solution of from 2 to 4 ozs. of sulphuric acid is gradually added during the drumming which is continued fifteen minutes longer. A solution of from 6 to 9 ozs. of bisulphate of soda may with equally good results be used in place of the acid.

The colored leather is next rinsed for a short time and then subjected to further treatment.

If complete penetration is desired 2 or 3 ozs. of ammonia are added to the dye-bath and the drumming is continued forty minutes longer; 5 ozs. of acid or three times as much bisulphate of soda are then added and the process is completed as described.

Dyeing with Basic Colors.—The method of coloring chrome leather with basic dyes most commonly used consists of mordanting it with tanning extract such as sumac, gambier or combinations of these two, or gambier and fustic, fustic extract also being often used alone. Dyeing may be done either before or after the skins have been fat-liquored. For the mordant, sumac is chiefly used for light shades, fustic for tan and yellow shades, and gambier for the darker ones. A decoction of 4 or 5 lbs. of sumac is sufficient for 100 lbs. of leather. After having been treated with sumac, gambier or fustic, the skins are dyed with basic colors. The dyeing should last fifteen or twenty minutes and the temperature of the bath should be 125° F. It is advisable to add the dyestuff to the leather in several portions through the hollow axle while the

drum is rotating. The drum should not be stopped until the solution of color has been in at least ten minutes, otherwise the leather may be spotted.

Sumac Mordant for Basic and Acid Dyes.—Chrome-tanned goatskins are nicely colored by carrying out the following instructions: Prepare a sumac liquor by using a decoction of 4 to 6 lbs. of sumac leaves for 100 lbs. of skins or a solution of 20 ozs. of extract of sumac; use at a temperature of 125° F., and drum the leather in it twenty minutes. Then pour into the drum 4 ozs. of titanium-potassium oxalate dissolved in a little hot water for 100 lbs. of leather and let the drum rotate ten minutes longer. Then drain the liquor out of the drum and drum the skins in the solution of dyestuff, either basic or acid dyes being used, preferably the latter. The result of this method of coloring is full, uniform shades of color. It is also good practice to apply the dyes first to the sumac-treated skins and the titanium salt afterwards. This gives clear, bright colors.

Gambier Mordant for Tan Shades.—For 100 lbs. of stock use 2 lbs. of gambier dissolved in 12 gallons of water; temperature 125° F. Drum the skins in this solution twenty minutes. Then pour into the drum 3 or 4 ozs. of titanium-potassium oxalate dissolved in hot water and let the drum turn ten minutes longer. Then drain out the liquor and color the leather with acid dye, or rinse it in warm water and color with basic dyestuff.

A liquor composed of equal parts of gambier and fustic is also an excellent mordant for shades of tan and brown.

Process for Tan and Brown Shades.—Drum the leather for ten minutes in a solution of 3 ozs. of titanium-potassium oxalate. Add 1 lb. of fustic crystals dissolved in boiling water and drum ten minutes. Then pour into the drum another solution of 3 ozs. of titanium salt and drum the leather ten minutes longer. Wash the skins, drain and dye them with phosphines shaded with brown to the exact color desired. Drum twenty minutes, then fat-liquor the leather (if not fat-liquored before dyeing) with a slightly alkaline fat-liquor and

finish as usual. 5 ozs. of liquid extract of fustic may be used for each dozen skins, or from 1 to 2 lbs. for 100 lbs of them.

Clearing the Grain of Grease.—Skins that have greasy grain may be cleared by being drummed fifteen minutes in a solution of 1 to 2 gallons of lactic acid in 50 gallons of hot water; they are then rinsed and treated with sumac, gambier or fustic, and colored. The acid removes the surface grease and opens up the pores of the grain so that the mordant and dye may go on more deeply and more uniformly.

Dyeing with Fustic Extract and Diamine and Anthracene Colors.—Wood dyes, such as fustic extract, may be used with diamine and anthracene colors in the production of fast colors upon chrome leather. The process is as follows: The leather is drummed for thirty minutes with the requisite quantity of fustic extract. The solution or dyestuff is then poured into the drum and the drumming is continued one-half hour longer. Complete absorption of the dyestuff is finally brought about, if necessary, by the addition of 2 or 3 ozs. of acetic acid per 100 lbs. of leather.

Color of superior fastness may be obtained by adding from 4 to 8 ozs. of bichromate of potash to the color bath before the acetic acid is added, and by working the goods at as high a temperature as possible, or from 150° to 160° F. The liquor is then drained out of the drum and the leather topped in a fresh bath with basic dyestuff. The leather is fat-liquored either before the dyeing is begun or after the topping with basic color. In the latter case it should be rinsed thoroughly before it is fat-liquored.

Light Shades, such as gray, drab, champagne, beige, biscuit, etc., are obtained by using acid dyestuffs in the following manner: The neutralized leather is drummed with the diluted solution of dye (3 to 4 ozs. for 100 lbs. of leather) at a temperature of 130° F., for ten minutes. The fat-liquor is then poured into the drum and the leather is drummed one-half hour. This method of working may be reversed by commencing with the fat-liquor and adding the dyestuff after some time, also by using both dyestuff and fat-liquor simul-

taneously. All that is needed to obtain complete penetration is to neutralize the leather completely and to prolong the drumming correspondingly. If necessary ½ to 1 per cent. soap may be added to the ordinary fat-liquor. It is usually advisable to add a decoction of from 6 to 8 lbs. of sumac or a solution of 3 to 4 lbs. of gambier to the bath after the fat-liquor has been exhausted by the leather, and to allow the drum to rotate one-half hour longer. The leather is then rinsed and set out.

The Use of Tartar Emetic.—Chrome-tanned leather, previous to the application of aniline dye, is usually prepared with some tanning extract, as has already been stated. When there remains upon the grain of the leather uncombined tannin imperfect coloring results. To prevent such defect and to fix the color upon the leather, some dyers use tartar emetic. The leather is run in the sumac, gambier or fustic liquor, as the case may be, the required length of time; tartar emetic dissolved in hot water is then added to the liquor in the drum and the leather drummed fifteen minutes longer. At the end of this time it is rinsed in warm water and colored with basic dye, then rinsed again and fat-liquored. 2 ozs. of tartar emetic are generally sufficient for one dozen skins.

Notes and Suggestions.—While fustic extract is used in coloring, it may be combined with the fat-liquor and the two processes of modanting and fat-liquoring performed at one operation, coloring being done afterwards. Fustic extract is the best material to use for tans and yellows, provided an acid dye is used afterwards. Sumac is the most satisfactory bottom for basic dyestuff.

When the dye solution is neutral, soluble oil or acid fat-liquor may be added to it and fat-liquoring and coloring accomplished in one process. Darker shades are obtained by adding ¼ per cent. bichromate of potash to basic color solutions after the leather has been drummed several minutes.

One practical way to use acid dyes is to drum the skins in a weak solution of formic acid and then to pour the dye solution into the drum and process the leather until the desired shade is obtained.

When chrome-tanned skins are colored after they have been fat-liquored more dye is required than when coloring is done previous to the fat-liquoring. This is due to the fact that the fat-liquor prevents the penetration of the dyes into the pores of the leather. On the other hand, when the leather is colored before it is fat-liquored the hot fat-liquor removes much of the color and makes it difficult to get the exact shade that is wanted. Basic dyes have the advantage over acid dyes in the fact that with them no acid is used, which decomposes the soap in the fat-liquor and injures the color. When acid dyes are used the leather should be washed and freed from every trace of acid before it is fat-liquored. It is the custom to color and fat-liquor chrome leather before drying it out, since it is not practicable to color the leather by the usual methods after it has been dried. It is said, however, that the leather can be fat-liquored and dried and then wet back and colored with acid dyestuffs in a bath to which a quantity of bisulphate of soda has been added. The process is as follows: The acid dye is dissolved in boiling water. A quantity of bisulphate of soda equal to the quantity of dye is dissolved in hot water in a separate vessel. Half of the dye solution and all of the soda solution are added to hot water sufficient to drum the leather, 12 gallons for 100 lbs. of leather, the skins being drummed in the liquor fifteen minutes. The rest of the dye is then added; the leather is drummed thirty minutes longer, then washed in warm water, set out and dried. From 8 to 10 ozs. of dyestuff are usually required for one dozen skins. This method of dyeing is said to color satisfactorily leather that has been dried after fat-liquoring.

It has been found that a better finish can be secured upon skins that have been given a light retannage with some vegetable tanning extract either before or during the coloring process. On such a bottom acid dyes are used successfully. A mixture of 2 per cent. fustic extract and $\frac{1}{8}$ per cent. logwood crystals produces excellent results as a mordant. After having been colored with aniline dye upon this bottom the skins are drained, and fat-liquored with an acid fat-liquor, or an

emulsion of oil and eggyolk. Some dyers use basic color on top of an acid color, which makes the color faster to the fat-liquor. Applying first fustic and logwood, then acid dyestuff and topping off with basic dye is one of the best methods of obtaining tan and golden-brown shades that can be used. Sulphuric or formic acid added towards the end of the process increases the depth of color. Formic acid is preferable to sulphuric acid since the latter is liable to cause greasy spots by curdling the fat-liquor. A good way to dissolve the dye is to have a pailful of boiling water and to shake the dyestuff into it from a sheet of paper, the solution being stirred with a hardwood stick until the dye is dissolved. It is often advisable to strain the solution through two or more thicknesses of cheesecloth before using it so as to remove the sediment. Acid and basic dyestuffs do not mix in solution, some of the dye being precipitated and the shade of color that is obtained is very unsatisfactory.

Some dyers do not put the dye directly into boiling water to dissolve it. They mix it thoroughly with cold water and boil with steam. Some dyes when put directly into hot water form solid masses and settle to the bottom of the vessel. It is always best to add formic or acetic acid to hard water before using it in coloring leather.

The following points should be taken into consideration in the treatment and selection of skins for colored leather. Only healthy skins with a clean grain are suitable. The substance of the skins should be preserved as much as possible by the use of fresh soaking liquors; by keeping the skins as short a time as possible in the beamhouse processes; by degreasing greasy skins; by using a tanning process that produces full, thoroughly tanned leather that dries out soft even when very little fat-liquor has been used; and by using a fat-liquor that penetrates thoroughly into the leather without any stickiness or greasiness about either grain or flesh.

Dyestuffs should be stored in a dry room where they are well protected from dust and moisture. After a package has been opened it should be well closed up again to prevent the

contents from becoming mixed with particles of dyestuffs floating about in the air, and from absorbing moisture from the air.

The dyestuffs are dissolved to best advantage in wooden tubs or in enameled, earthenware or porcelain vessels. Metal vessels are not so well suited, they being apt to affect the solutions of some dyestuffs. For dissolving it is best to use either distilled water, pure condensed water or rain water. In the case of basic colors it is well to correct hard, limey water before use with acetic or formic acid. Basic colors are dissolved by stirring them into boiling water, to which the requisite quantity of acid may be added; in the case of large quantities the dye solutions should be passed through a filter or hair sieve. Dyestuffs which are not readily soluble are mixed to a paste with some acetic acid, hot water being afterwards poured over the paste. Acid dyes are dissolved without the addition of any acid, and the same applies to anthracene and diamine colors. The solubility of some of the anthracene colors is improved by mixing the dyestuff first with one-half its weight of ammonia and then pouring hot water over the paste. The immedial colors are stirred into a boiling sulphide of sodium solution. An equal quantity of sodium sulphide as of dyestuff or half as much again is required.

It is not generally advisable to keep large quantities of dyestuff solutions in stock. By standing for some length of time the concentration is apt to change through the precipitation of a portion of the dyestuff, exact working being thus rendered more difficult.

If fastness to rubbing and good penetration have to be considered the acid colors are to be given the preference. Special attention has to be paid to thorough neutralization before dyeing, if good penetration be required, because any acid remaining in the leather will fix the dyestuff entirely on the surface of the leather. The requisite acid is therefore usually not added until the dyeing is nearly completed.

Coloring with Natural Dyestuffs.—A few practical instructions are here given by means of which chrome-tanned goat-

skins can be colored desirable shades without the use of artificial dyes. Fast colors are obtained by using dyewood extracts and the cost of the materials is less than that of aniline dyes.

Light Tan Shade.—Take the shaved skins and put them into the drum together with 12 gallons of water heated to 125° F. In a clean pail dissolve in hot water 2 lbs. of fustic extract, lemon shade. Start the drum ; and then pour into it the solution of fustic extract and drum the skins in it for one-half hour. Then add to the liquor in the drum 4 ozs. of titanium-potassium oxalate dissolved in a little hot water and let the drum run fifteen minutes longer. The skins will then be found nicely colored and should be washed and fat-liquored. The color if not quite satisfactory can be modified by the use of aniline dye.

Dark Tan Shade.—Run the skins in a solution of 4 lbs. of fustic extract, red shade, at a temperature of 125° F., for thirty minutes, using 12 gallons of water for 100 lbs. of leather. When the thirty minutes are up add to the liquor without stopping the drum, 6 ozs. of titanium-potassium oxalate dissolved in a little hot water. Allow the drum to turn fifteen minutes longer, then wash and fat-liquor the skins.

Oxblood Shade.—A desirable shade of oxblood is produced in the following manner: Dissolve by boiling in a few gallons of water 2¼ lbs. of hypernic extract, 2 ozs. of logwood extract and ½ oz. of leather red for 100 lbs. of leather. Add sufficient water to make 12 gallons of liquor and use it at 125° F. Drum the skins in this liquor thirty minutes. Then dissolve and pour into the drum 4½ ozs. of titanium-potassium oxalate and allow the drum to rotate fifteen minutes longer. The skins are then in condition to be washed and fat-liquored.

Chocolate Shade.—For this color use 2¼ lbs. of fustic extract, lemon shade, 10 ozs. of hypernic extract and 3 ozs. of logwood crystals in 12 gallons of water for 100 lbs. of skins. After the drum has been running thirty minutes pour into it 5 ozs. of titanium-potassium oxalate dissolved in hot water. Run the drum fifteen minutes longer, then wash and fat-liquor the skins.

Dyeing Chrome-tanned Goatskins Black.

Chrome-tanned goatskins may be dyed black in a variety of ways. The customary method at the present time is to dye them in a drum, using logwood extract and direct leather blacks, thus obtaining a full black in one operation, and to fat-liquor them after they have been blacked. The skins should be thoroughly neutralized and shaved before they are dyed.

1. *Dyeing with Hematin Crystals or Logwood and Direct Leather Black.*—This is one of the most approved methods of blacking chrome leather. The pack of skins is weighed and thrown into the drum together with 12 gallons of water heated to 125° F., for 100 lbs. of leather. Dissolve 1 lb. of hematin or logwood crystals in boiling water and add a little ammonia to the solution. The liquor is poured into the drum through the hollow axle and the leather drummed in it fifteen minutes. Dissolve 1½ lbs. of direct chrome leather black C in boiling water and add the solution to the liquor in the drum, the leather being drummed fifteen minutes longer. The exhausted dye liquor is then drained out of the drum and the hot fat-liquor poured in. After it has been fat-liquored the leather is washed five minutes in warm water, then set out, oiled and hung up to dry.

2. *Dyeing with Logwood, Leather Black and Titanium Potassium Oxalate.*—For 100 lbs. of leather a solution of 3 ozs. of titanium-potassium oxalate is used, and the leather drummed in it for ten minutes. A solution of 1½ lbs. of logwood crystals, ½ lb. of chrome leather black and 4 ozs. of sal soda in boiling water, is next poured into the drum and the leather drummed fifteen minutes. Then a solution of 3 ozs. of titanium-potassium oxalate is added to the contents of the drum, and the drumming is continued ten minutes longer. The leather is then either washed, struck out and fat-liquored, or fat-liquored immediately after it is blacked and washed afterwards.

3. *Dyeing with Chrome Leather Black.*—The skins, neutralized and shaved, are fat-liquored and then thrown into the drum for blacking. A solution of 1½ or 2 lbs. of Chrome

Leather Black C (Cassella) in 10 gallons of hot water is poured into the drum and the leather is drummed with it for thirty minutes. The temperature at the beginning of the process should be 125° F. In order to fix the dyestuff 1 oz. of acetic acid may be added towards the end of the process, but in most cases this is not necessary. A black grain and a blue-black flesh are obtained when this process is employed. Logwood extract or crystals may be used with the direct black to increase the fullness of the leather. The logwood solution may be added along with the dyestuff or immediately afterwards. No striker or other assistance is required, the logwood becoming fixed upon the leather during the dyeing.

4. *Another Method of Direct Blacking.*—The following process can be used if the flesh side is wanted dark blue or blackish blue. The leather is first dyed at 125° F. in the drum with from 6 to 12 ozs. of Chrome Leather Black C in 10 gallons of water for twenty minutes; then ¾ ozs. of acetic acid is added for fixing the color, and ten minutes later 6 to 9 ozs. of Leather Black T B or T G (Cassella) are added to the liquor in the drum. The leather is next drummed ten minutes longer and then rinsed. Fat-liquoring may be done either before or after blacking. A small quantity of logwood extract or crystals, say 4 ozs., may be used with the direct black in the first part of the process.

5. *Blacking with Logwood and Iron Liquor.*—Boil in 12 gallons of water 3 lbs. of logwood extract and 4 ozs. of fustic extract for 100 lbs. of leather, and add 1 fluid oz. of ammonia to the liquor. Drum the skins thirty minutes. Then drain three-fourths of the dye liquor out of the drum and pour in, after the drum is turning again, 4 or 5 fluid ozs. of iron liquor in 10 gallons of water. After a further drumming for ten minutes the liquor is drained off and the skins are washed in running water to remove the iron.

6. *Dyeing with Chrome Leather Black and Logwood.*—Quantities of dye for 100 lbs. of leather: 1½ lbs. Chrome Leather Black C, 4 ozs. of logwood extract, 10 gallons of water. Use at 125° F. and run the leather in the dye thirty minutes, Drain the liquor out of the drum and pour in the fat-liquor.

7. *Dyeing with Logwood, Permanganate of Potash and Iron Liquor.*—This process is used in the following manner: In the drum are placed 450 lbs. of skins as they come from the shaving machine and 30 gallons of water heated to 120° F., the drum being then closed and started. Now dissolve 2½ lbs. of permanganate of potash in 55 gallons of water at 120° F. and then add 2½ lbs. of muriatic acid of 21° Bé., this solution being run into the drum through the hollow gudgeon. After ten minutes, stop the rotation of the drum, then open it and allow the liquor which is now spent, to run off. Close the drum and after starting it again, pour in through the hollow axle 2 gallons of iron liquor mixed with 45 gallons of warm water. After ten minutes stop the drum and allow the liquor to run off. Next dissolve in 45 gallons of warm water 3 lbs. of extract of logwood and 3 lbs. of sal soda, and after the drum has been started again add this liquor through the gudgeon. Allow the drum to run ten minutes, then stop it and remove the skins. The next step is the washing of the now black leather, which is done in a drum or twister supplied with running water. After being washed fifteen minutes the leather is ready to be fat-liquored and dried for finishing.

The iron-liquor referred to may be prepared by dissolving scrap iron in dilute commercial acetic acid. The liquor ready for use should stand 10° Bé.; but any suitable ferrous salt of iron may be used.

The muriatic acid should always be added to the permanganate solution when all the required amount of water is present and never to a hot concentrated solution of permanganate of potash. It is claimed that deep, rich and a more permanent black besides other advantages are economically obtained by using this process. Patented by William M. Norris, Princeton, N. J.

The Finishing of Chrome Goat Leather.

Oiling, Dyeing and Staking.—The next operation is setting out by hand or on a machine the grain of the leather and applying a solution of glycerine in water, equal parts of each,

thereto. This is put on with a sponge evenly over the skin. The leather is then placed grain to grain over a horse and left for an hour or two. It is then struck out again, somewhat harder than before, and given an application of oil upon the grain. The leather should be very thoroughly struck out, all wrinkles and marks of the tool removed and the grain laid down flat and smooth. The water should be pressed out of the leather before the oil is applied to the grain. Any one of the following oils may be used: Neatsfoot, olive, sperm or any other leather oil; mixtures of neatsfoot and olive or neatsfoot and paraffine oils are good also. For instance, equal parts of neatsfoot and paraffine oils makes a good oil for either dull or glazed finish. It is good practice to apply the oil warm. The skins are next hung up to dry. Colored leather should be dried in a darkened room, while the drying of the black leather is effected most satisfactorily in a warm room provided with fans to keep the air in circulation.

The dry leather should be kept in a clean, dry room until it is desired to finish it; it is then moistened and staked. Take a dozen skins at a time and put them into warm water in a clean tub and leave them in the same long enough to become wet; then place them in piles or in a clean box, cover the top or the pile with wet burlap, or canvas, or sawdust, and leave them until the next morning, when they will be found to be in good condition to be staked. Staking and drying should be continued until the skins are worked out dry and soft. It is well to stake the skins both ways on the machine. The necks and shanks are often staked by hand.

To remove roughness from the flesh the leather may be run on an emery wheel or on a fluffing machine. It is then seasoned and finished.

To Clear the Grain of Grease.—1. Prepare a lactic acid solution by adding one quart of the acid to six quarts of water. Rub this solution into the grain with a sponge and hang the leather up to dry. This treatment removes whatever grease there may be in the grain.

2. This is also good. Dissolve one ounce of black nigrosine

in one gallon of boiling water and when the solution is cold add a small quantity of wood alcohol. Apply this to the grain of the leather, rubbing it in well, then apply the seasoning for glazed finish.

Blacking Defective Spots.—Oil-soluble black aniline dissolved in benzine applied with a sponge to spots that are not well blacked, dyes them at once and improves the color of the leather.

Black Glazed Finish.—A brilliant black glazed finish can be obtained by using one of the seasonings prepared in accordance with the formulas given below. The seasoning or finishing ink should be rubbed well into the grain, a light and uniform coat being applied. Two applications of seasoning are always necessary to get a good finish and frequently it is advisable to apply a third coat. After the seasoning has been applied the skins are dried and glazed; then the second coat is put on, the skins dried again and glazed.

1. Logwood liquor, 6 quarts; blood, 2 quarts; orchil, ½ pint; water, 1 quart; ammonia, ¼ pint; milk, ½ pint.

2. The following receipt makes 9 gallons of seasoning. Beef blood, 14 pints; water, 1 pint; milk, 1 pint; glycerine, 2 tablespoonfuls; orchil, ½ pint; nigrosine solution, 1½ pints; ammonia, 1 pint; logwood liquor, sufficient to make 9 gallons. The nigrosine solution is made by dissolving ½ lb. of nigrosine black in 1 gallon of hot water. When all the ingredients are mixed add enough strong logwood liquor containing no alkali to make 9 gallons of finish.

3. Logwood liquor, 6 gallons; bichromate of potash, 1 oz.; blood, 2 quarts; ammonia, 2 quarts; glycerine, 1 quart; vinegar black, 2 quarts. Dissolve the bichromate of potash in a little hot water and add it to the logwood liquor. Add a little carbolic acid to the blood, then stir it into the logwood liquor. Next stir in the glycerine, vinegar black, and lastly the ammonia. Stir the mixture while it is being made and strain it through cheesecloth.

4. Blood albumen, 1 lb.; nigrosine J, 5 ozs.; logwood crystals, 1 oz.; wood alcohol, 1 gill. Dissolve the blood albumen in 1

quart of water over night. Put the nigrosine and logwood into 3 gallons of water and boil until dissolved. When the solution is cold, add the dissolved albumen and wood alcohol.

A little carbolic acid may be added to the seasoning.

The finishing of glazed leather requires skill and care. The luster must be clear and bright and the grain well worked down. After the glazing is completed the leather receives a very light application of finishing oil; it is then sorted into grades and tied up in bundles.

Seasoning for Colored Leather.—Eggyolk albumen, 1½ gallons; bichromate of potash, ¼ oz.; acetic acid, 10 ozs.; water, 5 gallons. Dissolve the albumen in the water; add the other ingredients, mix thoroughly; then add 1 teaspoonful of sperm oil and two quarts of water. Use this for the first seasoning. After the skins have been glazed once apply the following: Blood, 3 gallons; vinette, 2 pints; water 5 gallons.

Many leather manufacturers buy their finishes and seasonings ready-made, others prefer to prepare them themselves.

Dull Finish.—When dull-finished leather is wanted the skins are staked and trimmed, then given a coat of finish, dried, given another application of finish, dried again and then ironed with a hot iron. Heavy skins should be staked lightly after ironing, which makes them softer and fuller than when this is not done. A good seasoning for dull finish is made of: Ivory or other white soap, 1 lb.; neatsfoot oil, 1 pint; whole flaxseed, 8 ozs.; beeswax, 3 ozs.; nigrosine black, 3 ozs.; powdered aloes, 1 oz.; wood alcohol ½ pint.

Boil the soap, oil, flaxseed and beeswax in 2 gallons of water, and when the solution is cool strain it. Dissolve the nigrosine in 1 quart of water and add this solution to the first. Dissolve the aloes in the the wood alcohol and add it to the finish. Stir it throughly for several minutes. This makes a fine dull finish with a nice dry feel. The grain of the leather should be quite heavily oiled with neatsfoot or dull morocco oil before the skins are dried. The oil helps the color and makes a soft grain.

Alum and Vegetable Tannages.

Alum Tannage.—For some purposes alum-tanned skins, white and colored, are desired. Soft, well-tanned leather results from tanning pickled skins with sulphate of alumina and salt to which eggyolk and olive oil have been added. An addition of flour to the mixture imparts fullness to the skins. 100 lbs. of acid-pickled skins can be tanned by using 3 lbs. of sulphate of alumina, 2 or 3 lbs. of salt, 5 lbs. of flour, 2 lbs. of eggyolk and 1½ lbs. of olive oil.

The flour is made into a paste with a small quantity of cold water. The sulphate of alumina and salt are dissolved in a few gallons of water and to this solution one of 4 ozs. of bicarbonate of soda is added, and the eggyolk and olive oil are then thoroughly stirred in. Finally the flour paste is added and the skins are drummed with the mixture two or three hours, left in over night, drummed a while the next morning, and then hung up to dry. When dry the leather should be kept in a clear, dry room for some weeks before it is finished. It can then be finished white or colored any shade.

The skins are staked, buffed and drummed with 1 per cent. eggyolk and 5 per cent. French chalk. Sulphonated oil may be used in the paste with good results; it can also be applied to skins that have been tanned with alumina and salt without eggyolk. If colored leather is wanted the grain may be colored by hand and the flesh left clean and white. Delicate shades are obtained by using wood dyes combined with some acid color. Another way to color the skins is to bottom the leather with some wood color and then to top with basic dye.

Another process in which sulphate of alumina is used is as follows; Prepare the tanning liquor by boiling 12 lbs. of sulphate of alumina in 10 gallons of water in a clean barrel or tub. In a clean pail dissolve by boiling in 1 gallon of water 1½ lbs. of bicarbonate of soda. Pour the soda solution very slowly and with constant stirring into the solution of sulphate of alumina. The mixing must be done very slowly; otherwise the liquor will be spoilt. When cold it is ready for use.

To tan the pickled skins put them into the drum together

with 10 gallons of water in which have been dissolved 1 lb. of Glauber's salt and 3 lbs. of common salt, these quantities of alumina, salt and water being for 100 lbs. of skins.

Drum the skins with the solution of Glauber's salt for fifteen minutes; then drain off the liquor. Dissolve 4 lbs. of salt in 10 gallons of warm water and drum the skins with this solution fifteen minutes. Then pour into the drum without stopping it, one-half of the alumina and soda solution, and let the drum rotate from one to three hours; then take the skins out and place them over horses over night. The next day hang them up to dry. When dry put them back into the drum together with 8 gallons of water and drum ten minutes; then pour in the other half of the alumina and soda solution and drum the skins from two to three hours. Let the leather press and drain for twenty-four hours; then hang it up to dry. When dry store it away for two weeks before finishing it.

The fat-liquor that is applied to the skins is sulphonated oil or acid fat-liquor. For 100 lbs. of dried skins take 7 lbs. of the oil and stir it into 8 gallons of water at 95° F. Dampen the skins and let them lay until the next day; then fat-liquor them. Drum them with the warm solution of oil forty minutes; next place them over a horse until the next day; then strike them out on the grain and apply a mixture of French chalk, 2 parts of glycerine and 4 parts of water. Apply this liberally to the grain and then hang the skins up to dry. When dry dip them in warm water, roll into a tight roll and leave them over night. Then stake them and tack them smoothly onto boards. If they do not appear to be fully tanned, prepare a solution of sulphite of alumina and salt and retan them; and if they are not as soft as desired dampen them and give them another application of the fat-liquor.

Kid Glove Leather.—The tanner who wants to make mocha castor glove leather will find the following process satisfactory. The skins, after they have been soaked and softened, are fleshed and limed. Liming should be done in clean white limes containing no red arsenic or sulphide of sodium. The

first lime should be clean, white and weak, the skins being passed from it into stronger lime and limed very thoroughly; or a gathering lime may be used by hauling the skins out each day and adding fresh lime. When the hair comes off easily the skins should be unhaired and the grain frizzed. After frizzing, put the skins in weak lime water for two or three days, then wash them in warm water and drench them with lactic acid in a drum, 100 skins requiring about 1 quart of acid in 10 pailfuls of water at 90° F. Drum the skins in this solution for one hour, next rinse them.

The tanning is done with alum, salt, eggyolk and flour. For each dozen skins dissolve 12 ozs. of alum and 4 ozs. of salt so as to make 1 pailful of liquor and drum the skins with this solution for thirty minutes; then add 1 pailful of flour for each ten dozen skins and 1 quart of fresh eggyolk, and drum the skins thirty minutes longer. Take them out of the drum and hang them up to dry. When dry put them away in a dry, cool place for a few weeks to give them time to become completely tanned. To finish the skins, dampen them and mill them in flour, next knee-stake them, dry them again and then run them on an emery wheel set with fine emery. After this has been done wash them with water and give them 2 quarts of eggyolk to twelve dozen skins. Then dry them again, knee-stake them and finish them on the finest emery. The skins should now be very soft, dry and white, and can be used for white gloves without further treatment. If colored skins are wanted, they can be easily colored any shade, then dried and staked, and finished on the finest flour emery. This process can also be used for grain-finished skins. For such goods, however, it is best to use arsenic with the lime and a dung bate to delime the skins. The leather finishes soft and strong and with a fine appearance.

Very fine glove leather is also made by tanning the skins with alum and salt, or with sulphate of alumina and salt, drying them and then wetting them back and retanning them with chrome liquor, as described for sheepskins.

Vegetable-tanned Goatskins.—The vegetable tannage that is

most commonly employed for tanning goatskins is sumac, although gambier is also sometimes used. The processes of tanning with these materials are the same as for sheepskins and are quite fully described in the sheepskin section of this book.

SECTION FIVE.

Some Practical Methods of Bleaching Leather.

Bleaching Chrome Leather.—The color of chrome-tanned leather can be made lighter by drumming in a hot, weak borax solution for a quarter of an hour and then in a weak sulphuric acid solution for the same length of time, 1 lb. of borax or bleaching soda for 100 lbs. of skins being used in water at 125° F. The acid bath should be as sour as a lemon. When very pale shades are wanted, such as pale greys, etc., the color of the leather itself can be improved by passing the skins through a solution of 1 per cent. oxalic acid, and next through a solution of sugar of lead, from one minute to two minutes in each solution, and then rinsing in water. The treatment may be several times repeated if the skins require it.

Another method of getting very light colored chrome leather consists of a treatment with flour. The skins are washed, neutralized and shaved in the regular manner, and are then given the flour in a drum, 50 lbs. of it being used for 100 skins. The flour is stirred with water into a thin paste and the skins are drummed with it two hours. If the leather is not to be colored it is next fat-liquored with acid fat-liquor and dried. It is then dampened, staked, milled in a dry wheel with powdered chalk or soapstone for one hour, and then arm-staked. If the skins are to be colored some very delicate shade they are washed after the flour treatment, fat-liquored with acid fat-liquor or with eggyolk, and colored with acid dyestuff, dried and staked.

Bleaching with Borax, Sumac and Sulphuric Acid.—In the coloring and finishing of skins that have acquired a dark color from the tannage, it is advantageous to retan them with sumac, which not only puts the goods into good condition to

be colored, but also makes them softer and more desirable in every way, especially when the leather is rather hard and firm from the tannage.

One way to accomplish the object of the process is to moisten dry skins by dipping them into warm water and placing them in piles for a number of hours to soften. They are next placed in a drum and washed in warm water containing borax, for twenty minutes, when the water is run out and a fresh supply run in, and the skins are again washed. In some cases one washing is sufficient.

The leather is then treated with a weak acid liquor made of water and enough sulphuric acid to make it as sour as lemon juice, the skins being drummed in this twenty minutes. They are next washed in two or three changes of water. The sumac liquor to which the leather is next treated consists of 1 to 2 lbs. of sumac for each dozen skins. The temperature of the bath should be about 100° F., and the skins be drummed with it until they have absorbed all the tannin, when they are rinsed off and set out. Coloring may be done at once with acid or basic dyes, or the skins may be dried and colored later on. For medium shades the above described process is satisfactory, but for very light shades sugar of lead and sulphuric acid are frequently used.

Bleaching with Sugar of Lead and Acid.—This process of bleaching vegetable-tanned skins makes the leather nearly white, but its use has unpleasant features. None of the coloring matter is removed from the leather, the light color being the result of lead sulphate deposited on the grain. It is generally advisable to retan the skins with sumac before bleaching them. To prepare skins for this process they should be taken in the dry condition and thoroughly softened with warm soft water, and then be milled in a drum with warm water containing borax until all particles of dirt, dust and tannin are removed. The next process is treatment with sumac, which is also applied in a drum.

The quantity of sumac required by a lot of leather is determined by the size, thickness and condition of the skins,

and ranges from 1 to 2 lbs. for each dozen. The sumac liquor is used at a temperature of 100° F., and the skins should be drummed in it until they have absorbed all the tannin. They are then bleached, which may be done either in a drum or in a paddle by running them in a sugar of lead solution of about 2½ per cent. for thirty minutes, then transferring them to a bath of sulphuric acid of about 3 per cent., and leaving them therein until they become white. The operations may be repeated as many times as may be necessary to get the skins bleached. It is very important that all traces of the acid be removed before the skins are colored.

Bleaching with Hyraldite.—Hyraldite is the stable formaldehyde compound of hydrosulphite and is extremely well suited for bleaching vegetable-tanned leather. Two pounds of Hyraldite C extra are dissolved in 10 gallons of water, and to the solution 4 lbs. of formic acid of 85 per cent. added. The leather is worked in this solution for a few minutes at about 85° F. until the desired effect has been attained. The leather is then rinsed well and subjected to the further customary manipulations. The bleaching liquor may be diluted still further as required.

Bleaching with Hydrosulphites.—Hydrosulphite compounds are used for bleaching leather in the following manner: Dissolve 1 lb. of hydrosulphite in 50 gallons of water or weak tan liquor in a suitable tub and stir until well mixed. As soon as the bath is prepared the skins should be suspended in it for one hour, when they are taken out, rinsed and dried. The solution should be prepared immediately before it is to be used. Hydrosulphite may be bought ready for use or it may be prepared as follows: 10 parts of zinc dust are stirred up with 50 parts of water, in which a little ice has been dissolved, and 100 parts of sodium bisulphite are then added slowly and with constant stirring, to the solution of zinc dust. The temperature of the mixture should not rise above 50° F. After it has been stirred for several minutes the solution should be allowed to settle. The clear solution is then diluted and used.

Bleaching with Bisulphite of Soda.—The color of leather can be improved by bleaching with bisulphite of soda and hydrochloric acid. The bath is prepared by adding 6 lbs. of liquid bisulphite of soda or of potash to 20 gallons of water. To this solution add slowly from 1 to 2 lbs. of commercial hydrochloric acid previously diluted with an equal volume of water.

Place the skins in the bath and stir them about until they are bleached throughout. A little more acid may be added to the bath if the skins seem to require it. The process can be carried out in a vat, paddle or drum. Bisulphite of soda in liquid form contains from 16 to 18 per cent. of sulphur dioxide, hence its employment as described. The addition of the acid to the solution liberates the whole of the sulphur dioxide gas.

Bleaching with Sodium Peroxide.—To bleach with sodium peroxide add 2 lbs of concentrated sulphuric acid to 20 gallons of water in a suitable tub; then add slowly and with constant stirring, sprinkling it into the solution, sodium peroxide until the acid is neutralized, which may be ascertained by testing with a piece of red litmus paper. Use the bath as soon as it is prepared and immerse the skins to be bleached in it for several hours.

Bleaching with Permanganate of Potash.—Permanganate of potash used in conjunction with sulphurous acid provides an efficient bleach for vegetable-tanned leather. The process consists of two baths, the first one being a solution of permanganate of potash, made by dissolving from 4 to 6 ozs. of the salt in 100 gallons of water. The skins are suspended in this solution for thirty minutes; they are then transferred to a solution of sulphurous acid. This is prepared with sulphur dioxide gas, which can be purchased in liquid form in a copper container. The sulphurous acid bath is made by connecting the cylinder or copper container to the vessel containing the water for the bath and charging the water with the sulphur dioxide gas. The skins are left in this bath until they have assumed the requisite light shade.

The effectiveness of this process is due to the strong oxidiz-

ing action exerted on the leather by the permanganate of potash. A great deal of care must be exercised in using this bleach as there is danger of injuring the leather.

Bleaching with Borax and Lactic Acid.—Combination-tanned stock that is to be colored for Russia leather and other colored leather is bleached and cleared by the use of borax and lactic acid. Commercial lactic acid may be used or bran may be soured and the acid obtained in that way. Put one bushel of rye bran into a barrel filled with water and let it stand until it is fermented and sour; it is then ready for use. One hundred pounds of dry leather previously fat-liquored require about 3 lbs. of borax and 2 pailfuls of the sour bran liquor. The leather should be moistened and softened by dipping it into hot water and leaving it in piles until it is soft, when it should be put into a drum together with seven pailfuls of water at 90° F. Put the water and the borax solution into the drum together with the leather aud drum ten minutes. The bran liquor should then be thrown in and the drumming continued for fifteen minutes. Then wash the leather thoroughly and, as a bottom for the color, give it some wood-dye, such as fustic, peachwood, hypernic, etc. After coloring use alum to set the color. This process has no bad effect upon the leather. The borax cleanses the grain and saponifies whatever fat or grease there may be in the grain, and lactic acid opens the pores so that the coloring material can readily penetrate and produce deep and uniform coloring. When commercial lactic acid is used, 2 gallons of it are dissolved in 50 gallons of warm water, and the solution is poured into the drum after the leather has been run in the borax bath.

Bleaching with Oxalic Acid.—Russet and colored leather can be bleached with oxalic acid. To make a barrelful of bleaching liquor; dissolve by boiling in 3 gallons of water one pailful of oxalic acid, and in 3 gallons of water in another vessel 2 pailfuls of salt. Put the solution into a barrel containing 10 gallons of water and then add this acid solution, and fill the barrel up with water to make 50 gallons of liquor. The leather is treated with this liquor after it is tanned or split.

Fifty sides or 100 skins should be given 2 pailfuls of the acid and salt and seven pailfuls of water, and be drummed in the liquor fifteen minutes. If the leather is not clear enough on the grain for russet leather, a little more oxalic acid solution should be used. Some tannages need less bleaching than others.

After the leather has been bleached it should be washed in warm water until all traces of acid are removed. It is advisable then to scour it on the flesh side, press it, and hang it up to dry. The subsequent processes are fat-liquoring and coloring according to the kind of leather that is being made. Good russet leather is made by stuffing and drying the sides or skins; then buffing the grain and coloring with suitable dye, such as cake nankeen. The less color used the lighter the shade. Two coats of color are applied with a soft brush; the leather is wiped off with a sponge and hung up to dry, and later on finished as may be desired.

Oxalic acid and tin crystals bleach bark-tanned leather effectively. About 12 ozs. of the acid and 6 ozs. of the tin crystals will bleach 100 lbs. of dry leather. The acid may be used alone, but it produces the best results when combined with tin crystals. The leather should have been fat-liquored and dried, than dampened and put into the drum together with six pailfuls of warm water and the acid and tin crystals dissolved in a pailful of hot water, and drummed twenty minutes. It should next be very thoroughly washed and given some wood dyestuff as a bottom for the color, and some set after coloring. This process makes a very clear grain on which beautiful shades can be obtained, but the leather is made somewhat harsh and the color does not penetrate very deeply; it is more suitable for bark-tanned than for combination-tanned leather.

Bleaching Bag, Strap and Collar Leather.—Much depends upon the condition of the leather throughout the tanning process in order to obtain a good color. The following single-bleach formula is giving satisfaction. When the leather comes from the shaving machine, run it, say thirty sides, in a drum with warm water until it is thoroughly wet, and then

run the water off. Next run the sides in a solution of 12 lbs. of common salt and 15 gallons of warm water for ten minutes, and then discharge the water and salt, after which run them in a solution of 3 lbs. of Wyandotte Tanner's Soda and 15 gallons of water for fifteen minutes longer. Run off this solution and give the sides a five minutes rinse in clean water so as to remove from them all traces of the soda; then rinse for eight minutes in 12 gallons of water at 125° F., to which have been added 3 pints of sulphuric acid. Drain the acid solution off and rinse the leather in clean water. Next run for one hour in a solution of 35 gallons of quebracho extract 16 degrees barkometer strength, and 8 lbs. of common salt. If a better color is desired, use sumac after retanning. A still better color may be obtained by adding ½ pint of dissolved tin crystals to the sumac liquor. A double bleach is carried out in the following manner: After the leather is split and shaved, retan it with quebracho extract of 16 degrees barkometer strength, either in a paddle or a drum. When retanned, put thirty sides in a drum of warm water and drum ten minutes. Then run the water off, and make a solution of 12 lbs. of common salt and 15 gallons of water, and drum the sides with this solution ten minutes more; then wash off the leather with warm water.

Next prepare a dip bleach, using four barrels. In the first barrel bring 5 lbs. of Wyandotte Tanner's Soda and 35 gallons of water at 125° F. In the second barrel use water at the same temperature as that in the first barrel. This is for the purpose of washing the soda from the leather. In the third barrel bring 35 gallons of water with sufficient sulphuric acid to bring the acid strength up to from 25° to 28° Bé. In the fourth barrel use 35 gallons of water at 80° F. The last barrel should be fitted with intake and overflow pipes so that the water may run freely through it, as the acid bath is very strong. After every fifteen sides have been bleached, strengthen the first barrel with ½ lb. of Wyandotte Tanner's Soda, and the third barrel with ½ cupful of sulphuric acid. When fifty or sixty sides have been bleached, the solution in

barrel No. 1 may be used in the drum, and a new solution made for this barrel the same as in the beginning.

The soda liquor that was used in the first barrel may be employed in the drum as follows: After the salt has been washed from the sides put thirty of them in a drum and run for twenty minutes in 10 gallons of this soda liquor to which have been added 15 gallons of warm water. Then wash well with warm water, after which use the dip bleach as given above, working the sides up and down three or four minutes in each barrel.

If a still lighter color is desired the sides may be treated with sumac in a drum or a paddle. Prepare the sumac by putting 6 gallons of ground sumac in one-half barrelful of water and steam for fifteen or twenty minutes. Turn off the steam and allow the sumac to cool. Dissolve a teacupful of tin crystals in 2 gallons of hot water and add one cupful of muriatic acid. When the sumac liquor has cooled, add to it the solution of tin crystals and muriatic acid. Run the sides in a drum in this solution for one hour. If a paddle wheel is used instead of a drum, the process should be continued for a longer time. The leather should be kept in motion while in the sumac solution whether it be in a drum or a paddle.

After the sumac process is completed the leather should be rinsed well with lukewarm water; then set it out on the flesh side. When it is dry enough to be reset, put a thick coat of moellon degras on the table; reset the leather, and give it a coat of neatsfoot oil on the grain side. Then tack it on frames and when dry finish it.

Bleaching with Gold Dust Washing Powder and Acid.—Hides and skins for bag and case purposes, as well as for any other colored leather, may be bleached with Gold Dust Washing Powder and sulphuric acid in the following manner: After the hides or skins are tanned or retanned and drained, put them into a drum with a solution of the powder made by dissolving 1½ lbs. of it in 50 gallons of warm water. This is sufficient for 50 sides or 100 skins. Drum the leather in the solution twenty minutes; then wash it off in clean cold water

for ten or fifteen minutes. Next add 1 pint of sulphuric acid and 8 lbs. of salt to 50 gallons of cold water and run the leather in this liquor for fifteen minutes, after which wash it for fifteen minutes in cold water. It is then ready to be fat-liquored.

If the soap in the fat-liquor darkens the leather, drain the drum and run the leather in 50 gallons of cold water into which 1 quart of lactic acid has been stirred. Next set it out with a rubber slicker, hang it up to dry and then finish it. The heavy loading of leather with extracts makes bleaching necessary. This process consists of removing the surface tannin with alkali and then brightening the leather with sulphuric acid. After bleaching it is necessary to wash out the acid so that it will not injure the leather.

Bleaching is done most expeditiously in a drum since more can be accomplished in it in thirty minutes than in a vat in an hour. Bleaching baths should always be maintained as nearly as possible at a uniform strength during the treatment of a mass of leather in order to secure uniform results.

Bleaching with Tanning Material, Alkali and Acid.—A process of bleaching with tanning material, alkali and sulphuric acid is carried out in the following manner: A bleaching liquor is prepared by making a solution of tanning material in the customary manner, the strength of the same depending upon the character of the leather and the tannery practice. In this process the bleaching solution should preferably be of the same, or of greater density than the tanning liquor to which the leather was last subjected in the tanning process. A certain amount of alkali, or of a combination of alkaline ingredients, is added to the solution of tanning material. The quantity added should not only be sufficient to clarify the solution or dissolve the undissolved constituents naturally present in the tanning material, but there should also be such an excess of it as to insure the bleaching effect of the dye, that is, the color which it is desired to impart to the leather, and according to the nature of the tanning material used. For securing leather of light colors the proportion of alkali must be greater than when dark-colored leather is desired; and if

the bleaching liquor is formed of the solution obtained from a bark, the proportion of alkali should be less than if it is made from other materials such as quebracho extract, etc. The mixture thus obtained is heated, preferably to from 100 to 140° F., and during the treatment maintained as nearly as possible at a uniform temperature, and also at a uniform strength or density by the addition, at intervals, of such quantities of tanning material and alkali as are required for this purpose.

The leather is immersed in the bleaching liquor, and is kept therein for from one to ten minutes, according to the character of the leather and the effect desired, the immersion being continued for a greater length of time to secure a denser product. By the term alkali is understood an alkali, alkaline salt, or a combination of alkaline ingredients, as for instance, sodium carbonate or borax, or combinations thereof.

After the bleaching in the alkaline bath, the leather is transferred to an acid bath. This acid bath should be maintained at as nearly a uniform temperature as possible, from 100° to 140° F., and the leather is immersed therein and allowed to remain a sufficient length of time to acquire the color and properties desired, a lighter color and heavier leather being obtained the longer the immersion is continued. After the acid treatment, the leather is taken out, drained, and washed with water to remove the acid. If it is desired to modify the color after the acid treatment, the leather may be immersed in a solution of tanning material, either with or without the addition of alkali, and allowed to remain therein until the desired color and effect are obtained. This may be done before the leather is washed with water.

In bleaching hemlock-tanned sole leather the procedure is as follows: Assuming that the tanning liquor in the last layer from which the leather is taken has a density of 40° barkometer, an alkali bleaching bath is prepared of a density of 45° barkometer, by dissolving 92 lbs. of quebracho extract, 14 lbs. of borax and 28 lbs. of sodium carbonate in every ten cubic feet of water (625 pounds). This bath is heated to 140° F., and the leather, taken directly from the last layer

in which tanning was completed, is immersed in it for five minutes, when it is removed, drained for a few minutes and then immersed in the acid bath consisting of 5 lbs. of sulphuric acid dissolved in 10 cubic feet of water, this solution being also heated to 140° F. In this acid bath the leather remains five minutes. It is then removed and thoroughly rinsed in cold water.

When operating upon a large number of sides, it is necessary to strengthen from time to time both the alkaline bleaching bath and the acid bath. In practice the density of the alkaline bath may fall to 40° barkometer, whereupon a sufficient quantity of very concentrated alkaline solution of quebracho extract containing the same ingredients as the alkaline bleaching bath and in the same proportions, must be added until the density of the alkaline bleaching bath again becomes 45° barkometer.

The acidity of the acid bath is maintained by adding after every fifty sides which have been immersed therein, from $\frac{3}{10}$ to $\frac{5}{10}$ lb. of sulphuric acid to every 10 cubic feet of water. If it is now desired to impart to this bleached leather an oak color, it is immersed in a liquor made from oak bark having a density of 40° barkometer and a temperature of 100° F., and allowed to remain therein until the desired color is obtained.

The above-described treatment results in very material advantages over the ordinary process of bleaching. First, the leather instead of being reduced in weight, is maintained or increased in weight, and consequently is of greater density resulting in greater durability. Secondly, the bleach, instead of being merely a surface bleach, is one that may be prolonged so as to affect the entire fiber of the leather, and articles made therefrom will not vary in color from the effects of wear. Thirdly, it is practicable, by varying the strength of the solution to produce any desired shade, and therefore, to operate upon a mass of leather with uniform results. The particular ingredients used, and the proportions of the same in the baths, and the density and temperature of the baths may be varied

and depend upon the tannery practice. This process is patented by Messrs. W. H. Krug and E. J. Haley.

Bleaching and Finishing Russet Leather.—After the leather is split by a belt knife, retan it in the usual way, and when it is tanned take it to the scouring table and scour it well on both sides; 25 sides make a convenient-sized pack to handle. Put them into a drum which should have at least a dozen plugs in it, close the door and run in through the axle 40 gallons of water containing borax. Prepare the borax solution before it is to be used by adding 10 lbs. of borax to 15 gallons of water. Boil until the borax is dissolved, then run in cold water to make 40 gallons. Start the drum as the borax solution is being put in; allow it to run twenty or thirty minutes; then remove the plugs and run it ten minutes longer. At the same time run in lukewarm water through the gudgeon or the door. Care must be taken to have the water not over lukewarm or the leather will be spotted. After a few minutes it can easily be seen whether the water coming from the drum is getting clear; then leave the leather in the drum and give it a strong solution of sulphuric acid made as follows: Take a barrelful of cold water and put in enough acid to bring the solution to 30° Bé., or until it will bite the tongue. Let the sides run in this ten minutes in the drum with the plugs in, then remove the plugs and run the acid water out while the drum is in motion, throwing in at the same time some water until no acid can be detached by the taste of the water coming from the wheel.

The leather should then be sumacked in a drum or paddle. Make the sumac bath strong and hot and add a handful of salt to it. Run the leather in the sumac liquor in a drum one-half hour; then rinse in clean warm water and slick out the flesh. The result will be a nice russet color.

If the leather is to be colored, the twenty-five sides can be treated at one operation. Dissolve the dye in boiling water. Add 8 pailfuls of warm water to the drum, put the leather in, add the dye slowly and run the sides in it thirty minutes; next rinse them in warm water and horse up for three hours;

then fat-liquor them. If russet leather is wanted no coloring is necessary. Give light fat-liquor, dry and finish.

A colorless dressing for russet leather is made as follows: To 5 gallons of water add ¼ oz. of bichromate of potash, 1 pint of acetic acid and 1 gallon of egg-albumen solution. Mix all together and keep in a cool place.

Another formula is: Dissolve 4 oz. of blood albumen in 1 gallon of water over night. Cook 4 ozs. of granulated gelatine in 1 gallon of water and let it cool. Mix ½ pint of white varnish shellac with ½ pint of ammonia. Mix all these materials together, and add enough water to make 3 gallons. This can be put on with a sponge, and it will make a handsome glaze.

For a plain natural finish give two coats and roll when wet, then hang up to dry. Now give another coat. If this finish is made up a week before it is used it will be all the better, as the ammonia will evaporate and fancy colors will be less apt to be spotted. Less ammonia should be used anyhow for colors.

Bleaching Mill-stuffed Harness Leather.—Place a barrelful of clear water at each end of the table. Heat the water in one barrel to 140° F., and keep the water in the other barrel as cold as possible. Throw a pailful of cold water over the table to prevent the grease from sticking to it. Put a side of leather, flesh side up, on the table, and then throw a pailful of hot water on it in such a way that the water will spread all over it as nearly at the same time as possible. Then brush over with oxalic acid solution made by dissolving two-thirds of a common teacupful of acid in a pailful of water, 2½ or 3 gallons of water heated to about the same temperature as the water being a pailful. Throw about 1 pint of the liquid on, right after the hot water and brush over quickly, and throw on a pailful of the water as soon as the acid has been rubbed in with a brush, which chills the flesh and prevents the hot water and acid bringing the grease back to the surface.

Apply the cold water in the same manner as the hot so as to chill the whole side at the same time. Then glass the flesh over and hang the side up to dry. Sides that are bleached

should be hung far enough apart so as not to touch each other before drying, and they will then dry out an even color. It is not necessary to slick the flesh out after the hot water is applied. The amount of grease that is slicked out of the flesh after hot water means just so much loss to the weight of the side. Throw a pailful of cold water on the table after each side is bleached, and slick the table off so as to take off any acid there may be on it, which will take off the black as soon as it comes into contact with it. This process is a satisfactory one, and two men can bleach one hundred and forty or more sides in a day.

Russet Skirting Leather.—The bleaching, stuffing and finishing of russet skirting may be accomplished by carrying out the following instructions: Take some forty sides, twelve to eighteen pounds stock, right from the liquor and have them skived and leveled. Then put them into the sumac vat and leave them for two hours to fill up and color. The vat should measure 5 by 9 feet and should be filled within one foot of the top. Put in one bag of dry Sicily sumac. Heat the liquor to 126° F. Instead of the slow process of using a vat, the sides can be bleached in less time in a drum. Put three pailfuls of dry sumac into one-half barrelful of water, heated to 140° F., then put this into the drum together with the leather and set the drum going. A short drumming is sufficient. After draining over night or being pressed the leather is ready for bleaching. This can be done in a drum as it is highly important to get a good light-colored base which will suffice for either russet or colored stock. Beside the drum put a barrel holding 50 gallons and into this drop 8 pailfuls of dry sumac and fill the barrel half full of water. Heat for half an hour at 140° F., and then add 4 lbs. of muriate of tin, which should first be dissolved in a pailful of boiling water. Fill up the barrel with water and heat the liquor to 125° F. Throw the forty sides into the drum, start it going, and through the open door throw in a pailful of the sumac liquor at a time until there is enough to thoroughly soak the leather. Drum one hour; then pull the plugs and let the liquor run out.

Next put 22 ozs. of sulphuric acid into a half barrelful of water and re-bleach the leather with it by drumming with it five minutes. This washing takes out all the rust, emery and bark stains. Then rinse the leather by washing it with cold water in the drum ten minutes. This completes the bleaching. The leather is then dried, soaked in cold water and packed down over night to be ready to be prepared for stuffing the next morning.

To stuff the leather, the following process is recommended: For 40 average sides, use 40 lbs. of wax, 3 lbs. of tallow and 25 lbs. of cod oil. After the leather is stuffed, set it out by hand and give the grain a coat of hot neatsfoot or sod oil. When dry, turn and reset it on the table by brushing it on the grain side with hot water. Take it over to the stoning jack and stone all over, giving particular attention to the grainy places. After the stoning, take the leather back and reset in on flesh and grain, then hang it up for final drying. It will then be in good condition to be stained any shade of color.

For russet, the leather, after being dried, should be sized on the flesh side with Irish moss solution and rolled while damp. When dry, size the grain with heavy flaxseed water to which have been added 4 ozs. of gelatine. Roll while damp and either glaze or dry-finish it.

Bleaching Sole Leather.—The bleaching of sole leather is accomplished in a very satisfactory manner by the use of Wyandotte Tanner's Alkali and sulphuric acid and the "dip machine" for bleaching leather, this machine being in line with the progress made in bleaching. The apparatus consists usually of five vats in a row, over which a hoist is built, so that the leather hung into frames holding ten to twelve sides, can be lowered simultaneously into the vats and raised again. The vats are usually built to hold 1000 gallons of water, and the frames constructed so that each side has allotted 4½ inches space.

The five vats contain usually: Vat No. 1, water; vat No. 2, alkali; vat No. 3, water; vat No. 4, sulphuric acid; vat

No. 5, water. All should be heated to 125° F., except vat No. 1, which should be heated to 130° F., as the cold leather upon being immersed usually lowers the temperature of the water from 5 to 8 degrees. These temperatures should be maintained uniformly. It is essential that the temperature of the vat following the acid vat should be equally as warm as that of the latter. Some tanners use here a cold water bath instead of one of the temperature of the acid bath, preferring to have the leather come out stiff and hard. But this is wrong, as the leather coming from the acid bath carries with it quite a per cent. of free sulphuric acid and this is sealed into it when it is placed in cold water, the latter contracting the fibers and retaining the acid to the injury of the leather.

The amount of alkali required for bleaching varies according to the condition of the leather and color desired. For oak leather 25 to 40 lbs. of alkali to start with will prove sufficient, and for union tannages 50 to 90 lbs. For hemlock and combination tannages the quantity required will vary from 70 to 120 lbs. to start with, according to the tannage.

The extracting or stuffing leather with extract, must also be reckoned with and seriously, as the extract stuffed in by milling consists of uncombined tannins and is more easily extracted than combined tannins. Therefore it would seem necessary that the tanning material used, the properties of the various combinations of tanning materials employed, and the general condition of the leather should be taken into consideration, and then the amount of alkali required to meet these conditions be determined. An alkali of given composition and strength is uniform and invariable in its action, and when varying results are obtained, they are usually due to a failure to maintain uniform conditions in the tanning process. For instance, should a sole-leather tanner increase the amount of chestnut-wood extract in his combination of tanning material used, he is changing the conditions of the leather and he must provide for these changed conditions by changing his bleaching quantities.

Where conditions are maintained uniformly an alkali of

given composition will invariably produce uniform results. The function of an alkali in bleaching is to liberate from combination a certain amount of tannin. The amount is governed wholly by the strength of the alkali solution used and the length of time the leather is immersed in it. The amount of tannin thus released is later on cleared out by the action of the sulphuric acid. It is essential that the strength of the alkali and acid solutions should be increased during the day, preferable after each dip.

A portion of the alkali in the alkali vat enters into actual combination with certain tans and non-tans, principally the latter, that have been extracted from the leather, and such alkali is useless for further bleaching and must be replaced. Also, the alkali that has been absorbed by the sides and that which hangs on the surface and fails to drip off is lost and must be replaced.

The amount required to keep the bleach strength at its full efficiency may be calculated on the basis of 10 per cent. of the amount used at the start, for every 50 sides bleached. Then, where 80 lbs. of alkali are used to make up the solution at the start, 8 lbs. should be used to strengthen for every side bleached. This amount may be divided into proportionate quantities and added to the solution after each dip, or the amount may be added after every four dips, that is, where the frames hold twelve to thirteen sides. But the former plan is preferable as it is most conducive to uniform results. The strengthening of the acid solution should be done on the same basis.

The amount of acid required depends upon the amount of tannin liberated by the alkali. On oak leather it usually takes 20 lbs. of 66° sulphuric acid to start the solution for every pound of Wyandotte Tanner's Alkali. On union and hemlock tannages 5 lbs. of acid to start for every 3 lbs. of Wyandotte Tanner's Alkali will suffice.

After the bleaching is successfully accomplished, leather of a desirable color is not assured unless intelligent care is given it in drying, poor color being often the result of careless handling in the drying lofts.

SECTION SIX.

The Manufacture of Kangaroo Leather.

Kangaroo skins are characterized by great suppleness, toughness and thick grain. The leather is very compact and resists the penetration of moisture, and does not readily crack or peel off. On account of its distinctive qualities it is a splendid shoe material, in a class by itself, and especially suitable for shoes for tender feet. Excellent leather is made by tanning the skins in a chrome process; also by tanning with quebracho or gambier. Dull-finished kangaroo leather has long been a favorite material for the tops of shoes, and glazed leather for vamps.

Soaking and Softening.—Kangaroo skins come from Australia and are received by the tanner in the dry condition. It is necessary to use some chemical in the soaks, such as borax, sulphide of sodium and caustic soda, to hasten the softening and to bring the goods to as near the natural soft condition as possible. Sulphide of sodium is an efficient softener. From 1 to 2 lbs. of it may be used for every 100 gallons of water in the vat. When the skins have become pliable they are taken out of the soak and drummed some time, then resoaked until they are thoroughly softened. The sulphide soak readily softens the skins and freshens up the dried and withered grain. The loosened flesh should be removed before the skins are put into lime.

Borax also softens the water and hastens the soaking of the skins, 5 or 6 lbs. of it being sufficient for 1000 gallons of water. Dissolve it with hot water; pour the solution into the soak and stir thoroughly; then throw in the skins.

Liming.—1. A liming process in which sulphide of sodium is used, that produces first-class results and that does not make

fine-hairing necessary, is carried out as follows: For 100 lbs. of skins 3 lbs. of lime and 1½ lbs. of sulphide of sodium are used as a first lime, the skins remaining in it one day. They are then hauled out and the same quantities of lime and sodium are added. On the third day the skins are hauled out, and put back after the lime has been plunged. On the fourth day the lime is strengthened and warmed to 80° F.; the skins are put back until the sixth day, when they are unhaired, washed and bated. If they do not unhair easily the liquor should be warmed and the skins left in a day or two longer.

2. Liming with lime and red arsenic produces fine-grained leather. To start with, the goods are put into a weak lime, containing 2 per cent. of lime calculated on the weight of the raw stock. After being in this liquor one day they are hauled out, and put back. On the third day 2 per cent. more of lime, well slaked, should be given. On the fourth day the skins are hauled out, the liquor is plunged and the goods are put back. To strengthen the lime on the fifth day 3 per cent. of lime and 2 per cent. of red arsenic, slaked together, should be added; and on the sixth day the goods are hauled out and put back so that those that were on top before are now on the bottom and those previously at the bottom are on top. On the seventh day 3 per cent. of lime and 2 per cent. of red arsenic are added. On the eighth day it is advisable to haul the skins out and to warm the liquor to 80° F., then to put the goods back and after leaving them one day longer to unhair them. They are next washed ten minutes in cold water, refleshed, worked for fine hairs and then bated. The exact quantity of lime to use and the number of days to leave the goods in the lime depend upon their thickness, heavy goods requiring longer liming than light, thin ones. Unhairing the skins in a strong solution of sulphide of sodium and then liming them in fresh lime liquor for a few days is another satisfactory process. After the goods have been unhaired they are refleshed and passed into the bating process.

Bating and Drenching.—1. There are many processes of deliming and bating that can be used, but the writer would

recommend the use of oropon bate, which is efficient, safe and clean to use. One-half pound of the material is dissolved in warm water for 100 lbs. of skins and used in sufficient water at 95° F., in a paddle or tub. The skins are turned from time to time for an hour or longer and then left in over night. The next morning they are taken out of the liquor, drained and pickled.

2. A slow, mild fermentation of an acid is an ideal condition for bating and this can be satisfactorily obtained by allowing grape sugar or glucose to sour and using definite portions of the same in conjunction with lactic acid. The process is a simple one and is easily carried out as follows: Dissolve 100 lbs. of glucose in 35 gallons of hot water in a barrel. Allow this to stand for two days in a warm temperature, when it will be completely soured. Prepare a paddle wheel with water at 95° F., and put into it 2½ quarts of the sour sugar solution. For every 100 lbs. of skins to be bated, take 1 pint of lactic acid and put half of it into the paddle wheel before putting in the skins. When the skins are in add the rest of the acid. Two or three hours is sufficient time to bate the goods; and when taken out, they should be washed with water and pickled.

The quantity of sugar solution mentioned is based upon the volume of liquor in the paddle wheel. The average capacity of a paddle wheel is between 2000 and 2500 lbs. of stock. There is no danger, however, in using an excess as the action of the sour sugar is very mild.

3. Another excellent method of deliming the skins consists of the use of sour bran and lactic acid. Prepare a paddle wheel with water at 120° F., and put into it 2 pailfuls of dry bran and allow it to stand over night. The next morning warm with steam to 95° F., and add to the bath 1 lb. of lactic acid for 100 lbs. of skins. Throw the skins in and run the paddle three hours; then take the skins out and wash them. Skins treated with this bate come out of the same soft and clean and, after washing, are in good condition to be pickled or tanned.

4. A method of deliming with sal-ammoniac and salt and pickling and drenching with formic acid is being used with good results and can be recommended for either chrome or vegetable-tanned kangaroo leather. For 100 gallons of water at 95° F. in the paddle, add 3 lbs. of sal-ammoniac and 10 lbs. of salt. Throw in the skins and agitate for two hours, then leave them in over night. The next morning transfer them to a paddle and run them one hour in a solution of 10 lbs. of formic acid, 85 lbs. of salt, 100 gallons of water at 85° F. This drench and pickle prepares the goods for any process of tanning and removes the last trace of lime.

Pickling.— No matter how the skins have been bated, it is advisable to pickle them. This is done with sulphuric acid and salt or with formic acid and salt. Pickling tends to make tanning more uniform.

1. A stock pickle is prepared by dissolving 40 lbs. of salt in 40 gallons of water, adding 5 lbs. of sulphuric acid. For pickling 100 lbs. of skins use 12 gallons of this liquor, drumming the goods with it one-half hour; then horse them up to drain.

2. For chrome tanning pickling with sulphuric acid is satisfactory; for vegetable (quebracho) tanning, the use of formic acid and salt is to be preferred, 15 to 20 gallons of water, 10 lbs. of formic acid and 25 lbs. of salt being used for 100 lbs. of washed skins. Drumming is continued one-half hour; the goods are then drained and tanned.

Two-Bath Chrome Process.—1. Excellent chrome leather is made by tanning the pickled skins in any one of the following processes.

Weigh the skins, and for each 100 lbs. of them, use 6 lbs. of bichromate of soda, 4 lbs. of salt, 3 lbs. of muriatic acid and 15 gallons of water. Boil the bichromate of soda until it is dissolved and add the solution to the water in the tub. Then add the acid and salt. Throw the skins into the drum and set the latter in motion. Pour the prepared solution into the drum and run the latter from one to two hours, according to the thickness of the goods. Horse the skins over night to

allow for draining and for the fixation of the chrome in the fibers.

The next morning prepare a 10 per cent. solution of bisulphite of soda and dip the skins, one at a time, into it, then place them in the drum. The second bath is prepared by dissolving 12 lbs. of hyposulphite of soda in boiling water and adding the solution to 15 gallons of water in a tub. Pour slowly into the solution 6 ozs. of muriatic acid, and then add 3 lbs of salt. Drum the skins in this liquor two hours, and then horse them up over night. The next morning wash and neutralize them for shaving and coloring.

2. In this process sulphuric acid is used in the first bath instead of muriatic acid, and bisulphite of soda is employed as the reducing agent of the second bath instead of hyposulphite of soda and acid. The quantities of chemicals and acid given are for 100 lbs. of skins. The first bath consists of 6 lbs. of bichromate of soda, 2 lbs. of sulphuric acid and 4 lbs. of salt in 15 gallons of water. The skins are drummed in this liquor from one to two hours and are then horsed up and allowed to drain until the next day.

The second part of the process consists of a solution of 6 lbs. of bisulphite of soda in 15 gallons of water. Drumming in this liquor is continued for from one to two hours or until the skins have assumed a light blue color throughout the thickest parts. After draining twenty-four hours the leather is neutralized and washed.

3. While pickling with acid and salt is in general use, it is also practicable to pickle the skins after they have been bated and washed, with sulphate of alumina and salt, 4 lbs. of each being used in 12 gallons of water for 100 lbs. of skins. Stock pickled in this manner can be tanned in either of the foregoing processes, also in a paddle according to the following directions:

The first bath consists of 6 per cent. of the weight of the skins of bichromate of potash or bichromate of soda and 3 per cent. of muriatic acid. The chrome is dissolved in boiling water and added to 65 gallons of water in a reel for every

100 lbs. of skins. The stock is run in this liquor several hours, then allowed to remain at rest over night. In the morning the skins are removed from the reel, struck out and dipped into a weak solution of hyposulphite of soda to which a little muriatic acid is added. After this has been done the stock is thrown onto a horse and allowed to remain a short time before it is placed in the second bath of the process. This bath consists of hyposulphite of soda, to which muriatic acid is added. The proportions are 18 lbs. of the hypo and 5 lbs. of the acid in 65 gallons of water for 100 lbs. of skins. The goods are turned in this liquor several hours or until the yellow color has entirely disappeared and the skins are a light blue throughout. They are then horsed up to drain twenty-four hours before they are washed and neutralized.

One-bath Process.—1. A leather of fine grain and texture is made by tanning kangaroo skins in a one-bath chrome process after they have been pickled with sulphuric acid and salt. The quantities of materials mentioned are for 100 lbs. of pickled skins. Place the pack in the drum together with 8 gallons of water and 6 lbs. of salt and drum for fifteen minutes. Dissolve in 6 gallons of boiling water 3 lbs. of tanolin. One-third of this solution is poured into the drum and the goods are drummed one-half hour; another portion of one-third is then poured into the drum and the goods are drummed another half-hour; finally the last portion is added and the drumming is continued one hour. Eight ounces of bicarbonate of soda are dissolved in a little water and poured into the drum and the leather is allowed to drum two hours; then 6 ozs. more of the soda are dissolved and poured into the drum and the leather is run until it is fully tanned. It is then horsed up for forty-eight hours to allow the chromium hydroxide to set, when it is washed and neutralized.

2. Another very satisfactory way to tan the skins is as follows: Take them after they have been bated and drenched and pickle them with sulphate of alumina and salt, using 6 lbs. of each dissolved in 8 gallons of water for 100 lbs. of skins, and drum one hour. Then after allowing the goods to

drain over night hang them up to dry. When they are dry, wet them back by washing in warm water, and retan them with chrome liquor. Tanolin or any other chrome tanning material can be used; also a liquor made of chrome alum as follows: Dissolve 8 ozs. of chrome alum in 10 gallons of water and drum the washed leather with this solution one hour. A solution of 20 ozs. of soda ash or 3 lbs. of soda crystals is then poured into the drum and the leather drummed two hours longer. It is then drained, washed and neutralized.

Neutralization and Washing.—After the leather has drained at least twenty-four hours it is ready to be neutralized. This is done by washing it in a drum one-half hour with water to which ½ per cent. of bicarbonate of soda has been added. The plugs are now drawn and the leather is washed for one-half hour with running water; it is then set out and shaved. This neutralizing and washing should always be done very thoroughly and before the leather is dyed and fat-liquored.

Dyeing Chrome Kangaroo Black.—1. One of the most approved methods of dyeing the leather black is as follows: Drum the leather in a few gallons of hot water. Then add a solution of 1 per cent. of hematin crystals dissolved in boiling water, adding 1 oz. of ammonia. After the leather has been drummed in this liquor fifteen minutes, pour into the drum a solution of 1½ per cent. of direct chrome leather black and and let the drum run fifteen minutes longer. The skins can then be drained and fat-liquored, or, without removing the spent dye liquor from the drum, pour in the hot fat-liquor and drum one-half hour longer. The leather should then be washed in warm water, set out, oiled on the grain and hung up to dry.

2. A fine black is also produced by this method: Drum the leather for ten minutes in a hot solution of titanium-potassium oxalate, using 3 ozs. of the same for 100 lbs. of leather. Then pour into the drum the dye liquor made of 1½ lbs. of logwood crystals, ½ lb. direct chrome leather black C, ¼ lb. of sal soda and 12 gallons of water. Let the leather run in this dye

twenty minutes. Then pour into the drum 3 ozs. more of the titanium salt in solution; drum ten minutes longer, wash and fat-liquor the leather.

Fat-Liquoring.—1. An acid fat-liquor that is recommendable for kangaroo leather is made of sulphonated oil and neatsfoot oil. Heat 6½ lbs. of neatsfoot oil to 160° F., together with ½ lb. of potash soap dissolved in a little water. Mix thoroughly and allow to cool; then add 6½ lbs. of sulphonated castor oil, thus making a rich emulsion with water. Three pounds or less of this fat-liquor is enough for 100 lbs. of leather. The addition of ½ pound of ammonia is recommended where there is a slight trace of acid in the leather.

2. A fat-liquor somewhat richer than the foregoing, that gives a still better nourished leather is made of 12½ lbs. of neatsfoot oil, 2½ ozs. of carbonate of potash, 3¾ lbs. of potash soap and 4 lbs. of sulphonated oil. Dissolve the carbonate of potash in a little hot water and stir it into the neatsfoot oil (or simply stir it in without dissolving it) and heat the oils to 160° F. Then add the potash soap and stir thoroughly. Shut off the steam and add the sulphonated oil, stirring thoroughly until a perfect emulsion results. This fat-liquor gives a well nourished feel to the leather, and the latter can later on be finished in dull or glazed finish.

3. A good fat-liquor for kangaroo leather is made of the following ingredients: Olive oil soap, 1 lb.; borax, 2 ozs.; neatsfoot oil, ½ lb.; eggyolk, 1½ lbs., for 100 lbs. of leather.

4. This is also recommendable: Fig or olive oil soap, 1 lb.; neatsfoot or cod oil, 2 lbs.; moellon degras, 2 lbs.; caustic soda, 1 oz. Boil the soap in 6 gallons of water until it is dissolved; next add the oil and boil fifteen minutes; then add the moellon degras and stir five minutes. The caustic soda dissolved in 2 quarts of water is added last. Enough cold water should then be added to make 12 gallons of fat-liquor for 125 lbs. of leather. Fat-liquors should be applied at a temperature of 125° F.

5. This fat-liquor and No. 4 are recommended for dull-finished leather. Moellon degras, 3 lbs.; salts of tartar, 4 ozs. Dis-

solve the salts of tartar in 3 gallons of hot water; then stir in the degras and stir thoroughly for several minutes; finally adding enough water to make 12 gallons of liquor. Use at 140° F.

Applying the Fat-liquor.—The most approved method of fat-liquoring chrome leather is to first dye the skins black and then wash them, pressing or striking them out to rid them of the surplus water. The drum, empty and clean, is heated with live steam; the condensed steam is drained out, and the leather thrown in and drummed a few minutes to warm it. The hot fat-liquor is then poured into the drum and the leather drummed in it forty minutes.

All the grease should be taken up by the leather, leaving nothing but water behind. Some tanners use the following method: The leather and a quantity of hot water are put into the drum and run ten minutes. The drum is then stopped; the hot water is drained off, and the fat-liquor poured in; or the liquor in a slightly concentrated form is poured in and, mixing with the hot water, accomplishes its purpose. It is also customary to add the hot fat-liquor to the dye liquor after the color has been exhausted. Finally the leather is placed over horses to drain at least twelve hours; it is then set out, oiled on the grain and hung up to dry.

Oiling and Drying.—After the grain has been well struck out a coat of oil is applied. For glazed finish use, 1 part neatsfoot oil and 3 parts paraffine oil, warmed and stirred together; or 1 part olive oil and 3 parts paraffine oil.

For dull finish use equal parts of neatsfoot and paraffine oils or neafsfoot oil alone. After the oil has been applied to the grain, hang the skins up to dry in a moderately warm room. It is best for the leather to dry rather slowly. When dry it is dampened and staked.

Staking and Tacking.—A good way to dampen the dry skins is to put a dozen of them at a time in hot water, allowing them to remain about two minutes; then pack them into a box and cover them about twelve inches deep with wet sawdust. The next morning they are staked and tacked on boards. When dry they are trimmed and seasoned.

Finishing.—A fine glazed finish is obtained by using the following dressing: Prepared blood, 15 pints; water, 1 pint; milk, 1 pint; glycerine, 2 tablespoonfuls; orchil, ½ pint; nigrosine solution, 1½ pints; ammonia, 1 pint. Make the nigrosine liquor by dissolving 8 ozs. of black nigrosine in 1 gallon of water. Mix the ingredients by thoroughly stirring; then add enough water to make 9 gallons of finish. This dressing is well rubbed into the grain, dried and glazed. A second coat is applied, dried and glazed again. A light coat of hot finishing oil is the finishing touch.

Dull Finish.—Ivory soap, 1 lb.; neatsfoot oil, 1 pint; whole flaxseed, ½ lb.; beeswax, 3 ozs.; nigrosine black, 3 ozs.; powdered aloes, 1 oz.; wood alcohol, ½ pint.

Boil the soap, oil, flaxseed and beeswax for one-half hour in two gallons of water. Cool and strain. Then dissolve the nigrosine in 1 quart of water and add to it the solution. Dissolve the aloes in the wood alcohol and add the solution to the finish, stirring thoroughly.

Apply a coat of this dressing to the grain of the skins and let it dry. Then apply another coat and allow it to dry. Finally iron with a hot iron, then stake the skins. Finished this way, the leather is soft and full and has a fine break and feel.

If colored kangaroo is wanted, the instructions given for calfskins and goatskins should be followed.

Vegetable-tanned Kangaroo Leather.

Quebracho Extract Tannage.—In the tanning of vegetable-tanned kangaroo leather quebracho extract is used, also a combination of quebracho and hemlock extracts, soft, well-tanned leather being also made by tanning the skins with gambier. When quebracho extract is used a convenient quantity of it is boiled into solution with water in a barrel to form a stock solution from which the tan liquor is made and strengthened. The first tanning liquor is rather weak, about 8° barkometer. The pickled skins are suspended in this liquor, which should contain some salt, and as the tanning

progresses the strength of the liquor is increased until it is about 20° barkometer. The time required for tanning depends upon the thickness of the skins and the strength of the liquor, and ranges from three or four days to two weeks. Salt should be present in the liquor to prevent the washing-out of the salt in the skins, leaving the acid to burn the fibers.

A tannage with quebracho extract, salt and alum produces full, well-tanned leather. To every 100 gallons of quebracho liquor of 4° barkometer strength add, while the liquor is warm, 2 lbs. of alum and 4 lbs of salt, and plunge the liquor well. At the end of 36 hours the skins are ready for the second liquor. Heavy skins may remain in the first liquor 48 hours. The second liquor consists of quebracho liquor of six-degree barkometer strength, gradually strengthened until the skins are tanned throughout. When taken from the liquor the leather is rinsed in warm water, fat-liquored and dried, then moistened, shaved, colored and finished.

When quebracho and hemlock extracts are combined, the proportions should be $\frac{2}{3}$ quebracho and $\frac{1}{3}$ hemlock. The tannage is begun in weak liquor, which is strengthened as the tanning proceeds until the goods are tanned throughout. When the leather is taken out of the liquor it is beneficial to drum it in a sumac liquor for an hour or two before drying it out.

Gambier and Sumac Tannage.—Kangaroo skins may be struck through by being run in a paddle in gambier and sumac liquors of 10° barkometer strength. There should be sufficient acidity in this liquor to keep the skins plump, they being tanned after bating and washing without pickling. It is well to add 1 quart of acetic acid for 50 skins being tanned. After running in this liquor a few hours, the skins are passed into a gambier liquor of 20° barkometer, to which acetic acid has been added. No doubt formic acid or butyric acid could be used with equally good results.

In this second liquor the skins remain about twelve hours. The third liquor should be made up to a strength of 35° barkometer and the same proportionate amount of acid be added

to it. A small proportion of oakwood extract added to the liquor helps in getting well filled-out leather. When well struck through the skins are ready for the sumac bath. This is prepared in a reel by adding water at 125° F. to 25 lbs. of best sumac and cooling down the bath to 90° F. before putting in the goods.

After laying in the sumac liquor over night the skins should be horsed up and drained, fat-liquored and dried. When thoroughly dry they may be dampened, shaved and dyed black. The leather is soft and well tanned. Good leather is also made by tanning the goods in a liquor made of gambier, alum, sulphate of soda and salt, in the proportions of 6 lbs. of gambier, 2 lbs. of salt, 1½ lbs. of alum, 1 lb. of sulphate of soda and ½ oz. of picric acid for one dozen light skins. Boil the gambier separately as well as the other ingredients and then mix the two solutions. The tanning liquor can be given to the skins in a drum, 1 gallon at a time, and drumming continued until the goods are tanned throughout. The skins need not be pickled, but are tanned after bating and drenching. Suspending them in the liquor is also a good way to tan them. After being fully tanned the leather should be drained, rinsed, pressed and treated with acid fat-liquor, then dried, moistened, dyed, and finished.

Other tannages.—Sometimes skins that have been tanned with gambier or with quebracho are retanned with alum, salt and soda, then fat-liquored and dried. The entire tanning process can be carried out in a drum. This produces a soft dongola leather.

Another form of dongola tannage consists of tanning the skins first with gambier, then giving them a sort of kid tannage in a drum, 100 medium skins, pressed from the tan, being given 2 lbs. of alum, 5 lbs. of salt, 12 lbs. of flour, 5 dozen eggyolks, ½ pint olive oil and 6 gallons of water. The alum and salt are dissolved in 2 gallons of water and the flour is next carefully stirred in. The other ingredients are then mixed with warm water and thoroughly stirred in. The skins are drummed with the mixture until they have absorbed it, when they are rinsed off, struck out and dried.

A combination of gambier, flour and sulphonated oil, thoroughly mixed and made into a sort of paste, also makes excellent leather. No subsequent fat-liquoring is necessary. One hundred medium skins free from acid, require 50 lbs. of gambier, 6 lbs. of salt, 2 lbs. of alum, 12 lbs. of flour, 3 or 4 lbs. of oil and 6 gallons of water. The gambier is boiled and cooled, and the other ingredients are then added. When dry, the skins are wet, shaved, dyed, dried again, staked and finished.

Black Grain and Blue or Black Flesh.—1. A good process of dyeing the leather is carried out in the following manner: Drum the leather in warm water until it is soft. If it was not treated with sumac after tanning it should be drummed with sumac liquor before it is dyed. Then for every 100 lbs. of dry weight, drum the skins for ten minutes in a solution of 5 ozs. of titanium-potassium oxalate. Next pour into the drum logwood liquor, slightly alkaline, and run the leather in it twenty minutes. Then pour in another warm solution of 5 ozs. of titanium salt and drum ten minutes longer. Drain the liquor out; wash the leather and set it out and oil the grain and hang it up to dry.

2. A fine blue flesh is secured by drumming the leather with a solution of acid blue dyestuff such as Naphthol Blue, using 8 ozs. of it with 4 ozs. of sulphuric acid or 8 ozs. of acetic acid for 100 lbs. of leather. The dyebath should be at a temperature of 115° F., and the leather be drummed with it one-half hour. It is dyed black on the grain with a solution of 1 lb. of leather black F G (for dull finished), 8 ozs. of acetic acid and 10 gallons of water. The dye solution should be at 125° F. during its application, two applications being generally sufficient. The dye is brushed on the grain by hand. The coloring of the flesh can be done immediately after tanning, the staining of the grain after the leather has been dried.

3. Both flesh and grain can be dyed black by drumming the leather in a solution of 1¼ lbs. of direct leather black T B or T G for 100 lbs. of leather, the solution being acidified with an addition of 4 or 5 ozs. of acetic acid.

4. *Yellow Flesh and Black Grain.*—Where leather is wanted with a yellow back and black grain, the skins are fat-liquored with acid fat-liquor after they are tanned, and they are then dried. Preparatory to flesh coloring the leather is wet in a tub of warm water and placed in a pile to soften. For 100 small and medium skins. ½ pailful of sumac is scalded with hot water for two hours. The sumac, four pailfuls of water, 1 gallon of lactracene together with the skins are put into a drum and drummed twenty-five minutes, the temperature of the liquor being 110° F. After the skins have been drummed in the sumac-lactracene liquor for twenty-five minutes, the yellow dye is added and the leather run in it for ten minutes. Dissolve 1 lb. of yellow S or other basic yellow in ½ barrelful of water and use 3 or 4 pailfuls of the solution for 100 lbs. of leather, dry weight.

After the leather has thus been colored yellow, dye the grain on a table or a machine with logwood and striker, or with a solution of direct leather black. Rinse the leather; set out the grain and oil it lightly and hang the skins up to dry for finishing.

A Patented Method of Finishing Kangaroo Leather.—An unstuffed kangaroo skin, tanned by a gambier, quebracho or other process, is fat-liquored with a suitable fat-liquor and then dried. The flesh-side is then colored blue or blue black by a suitable dye, and the grain is dyed black with logwood or other dyeing material. The skin is then slicked out smooth and dried; it is then staked and trimmed. The grain is next seasoned by the use of bluestone, iron, logwood, ammonia, blood and nigrosine, the proportions being as follows: Bluestone, ½ pint; iron, 1 oz.; logwood, ½ pint; blood, 1 pint; nigrosine black, ½ pint. The seasoned skin is dried in a warm room, then glazed and staked, next given another coat of seasoning, dried and glazed again, and then staked in the same manner as before. The skin is then again seasoned, dried and glazed again, which finishes it ready for use. The finished leather has a blue-black flesh, a black grain and a very bright finish, resembling glazed kid; it is also very soft and durable. This method of finishing leather was patented in 1899 by Christian E. and Henry A. Lappe, of Pittsburgh, Pa.

SECTION SEVEN.

The Manufacture of Leathers from Cowhides.

The processes that precede the actual tanning or conversion of hides into leather are about the same for all classes of soft, supple leather, whether the tannage be chrome or vegetable. The objects of these processes are to bring the hides to the point of tanning—unhaired, soft and clean—and in a condition that is receptive to the tanning liquor.

Soaking Green-salted Hides.—The hides are first trimmed, the tails, shanks and pates being cut off in the hide cellar, and they are then soaked. One of the most approved methods of soaking is to hang the hides in the water, which should be soft and clean. If the water is hard, 5 lbs. of borax, dissolved in hot water, should be stirred into it to make it softer and to increase its softening and cleansing powers. The hides should be hung in the water, from tail to head, and left therein for twenty-four hours. They are usually then taken out and cut into halves or sides. The water in the soak vat is run out and fresh water run in, when the sides are put back and soaked twenty-four hours longer. Splitting into sides can also be done after the second soaking. The object of the soaking process is to soften the hides and to remove from them the salt, blood and dirt that adhere to them. It is a matter of importance that the object of this process be accomplished in a thorough manner and in a short time in order that the hides may go into the limes clean and soft and yet retaining their substance intact. Prolonged soaking of salted hides results in a loss of gelatine and in loose and spongy leather. On the other hand, if the hides are not soaked enough to accomplish the objects aimed at, they do not go into the lime in the right condition, and the grain may have serious defects. It is usu-

SORTING UPPER LEATHER.

To face page 253

ally best to change the water once during the process. If the hides are very dirty, two changes are necessary; if only ordinarily salty and dirty, one change is sufficient. The changing of the water hastens the softening and makes the hides cleaner.

No exact rule for soaking can be given as much depends upon the thickness and condition of the hides and the temperature of the water. Usually, however, ordinary hides are sufficiently soaked by being hung in water twenty-four hours, then removed and resoaked another twenty-four hours. At the end of the soaking process, the sides are drained, fleshed, pinned together in a chain and passed into lime.

Soaking Dry Hides.—Hides that are received by the tanner in flint-dry condition require longer soaking and more thorough working in order to get them into the soft, pliable condition that is necessary before they can be fleshed and limed. The following method of soaking dry hides usually proves satisfactory: For every 100 gallons of water in the vat, dissolve 1 lb. of sulphide of sodium in hot water and pour the solution into the water, plunging thoroughly. Put the hides into the water and let them soak twenty-fours hours. At the end of that time, take the hides out of the water, put them into a dry mill and run them in it thirty minutes; next place them in a pile or piles, covered up, and let them lay twenty-four hours; then put them back into the water from which they were taken and let them soak twenty-four hours longer. From this soaking run the hides in the dry mill one-half hour; then flesh them. After fleshing, leave them in clean cold water over night; then lime them.

The hides should be split into sides before they are run in the mill. Formic acid is sometimes used in soaks to hasten the softening of dry hides, 1 lb. of the acid being added to each 100 gallons of water in the soak vat. The hides are first placed in clean water for a day or two and then hung in the acidified soak. If they swell excessively some salt should be added to check the swelling. After the hides have been soaked two or three days they should be washed and placed in clean water for a few hours and then placed in the lime.

When this method of soaking is employed it is advisable to use more than the usual proportion of sulphide of sodium in the limes to overcome the sterilizing action of the acid upon the hides. The process takes from two to five days. Formic acid, because of its antiseptic action, prevents decay of the hides while they are being soaked.

An excellent method of softening the hides with the acid is carried out in the following manner: After having become soft and pliable, they are allowed to drip thoroughly and are then salted and placed in a pile for two or three weeks, next washed thoroughly and placed in cold water for twenty-four hours and then passed into the first lime.

A strong salt solution is an efficient softener for dried hides. The goods are left in it three or four days or until they are flexible. They are then worked in a hide mill or a drum and resoaked in salt water until they are soft. A quantity of formic acid added to the salt soak increases its softening effect. Before the hides are limed, the salt should be gotten rid of by washing them in clean, cold water.

Sun-dried hides should be unhaired with sulphide of sodium in the limes since such a process swells the fibers and freshens up the withered grain more than does lime alone or lime and red arsenic. Unhairing in a strong solution of the sulphide of sodium and then liming for a few days is another excellent process for dried hides. Soaking in a sulphide soak supplemented by working in a dry mill is usually found to be the most satisfactory process that can be used on dry hides for upper, harness and sole leather.

Liming Hides for Upper Leather.—1. Green-salted hides that are intended for soft, supple leather, chrome or vegetable tanned, worked through a liming process according to the following directions will be found to be sufficiently limed for unhairing in six days. Exact quantities of lime and sulphide of sodium can be used, namely, 8 lbs. of lime and 2 lbs. of sulphide of sodium for every 100 lbs. of hides.

To start the liming process, slake 1½ lbs. of lime, add to it the water in the vat, and plunge up well. Reel the chain of

hides into the prepared lime, taking care that each side is spread out flat and is not rolled, folded or twisted. After the hides have been in this lime twenty-four hour hours, reel them into the second lime, made by adding the same quantity of lime to water that was used in the first lime. Leave the hides in this lime twenty-four hours. Then make up the third lime the same as the second lime and allow the hides to remain in it twenty-four hours. Reel them into the fourth lime, which should also contain the same quantity of lime, namely, 1½ lbs., and leave them in it twenty-four hours. The fifth lime should contain 1 lb. of lime, and the hides should remain in it twenty-four hours, when they are reeled into the sixth lime which should contain 1 lb. of lime and 2 lbs. of sulphide of sodium. This lime should be warmed to 75° F., and the hides be left in it twenty-four hours, when they are reeled into warm water and unhaired after two or three hours. The positions of the hides should be changed every day and fresh lime be used every day, the hides remaining in each lime twenty-four hours.

After the hides are unhaired, wash them for fifteen minutes with running water, next place them in warm water and work them over the beam and then put them into the bating liquor. The above-described process produces very uniform leather. The sulphide of sodium in the last lime helps to remove the fine hair, such removal being very essential for grain-finished leather. The hair should come off easily and clean. Unhairing out of new lime gives hard, plump hides, a condition that is desirable for chrome tannage and for splitting out of lime. The hides, after unhairing, can be split, or they may be bated and pickled and then split, or bated, pickled and tanned and split after they are tanned.

Although 8 lbs. of lime will unhair 100 lbs. of hides, softer leather is obtained by using 10 lbs. of it in six limes, starting with 1½ lbs. and using 2 lbs. each day until the hides reach the fifth lime, which should contain 2½ lbs. of lime and 1 lb. of sulphide of sodium. Either of these processes produces satisfactory results for chrome or vegetable tanning. If the

hides are to be split out of lime, they should be unhaired, put into warm water and worked by hand over the beam and left in cold water over night to harden for splitting.

2. Sides that are intended for shoe leather and other soft and supple stock may be limed and unhaired with most excellent results according to the following instructions. By calling the pits A, B and C and numbering the packs the method of procedure may be readily understood. The quantities of lime and sulphide of sodium are based on 100 lbs. of wet, fleshed hides. The temperature of the limes should be maintained at 70° F. The process is as follows:

First day. Pack No. 1 is put into pit A, containing 5 per cent. lime and 1 per cent. sodium sulphide.

Second day. Pack No. 1 is transferred to pit B, containing 5 per cent. lime and 1 per cent. sodium sulphide. Pack No. 2 is put into pit A, once used.

Third day. Pack No. 1 is put into pit C containing 5 per cent. lime and 1 per cent. sodium sulphide. Pack No. 2 is transferred to liquor B, once used. Pack No. 3 enters pit A, twice used.

Fourth day. Pack No. 1 is removed. Pack No. 3 is drawn from A, and new liquor consisting of 5 per cent. lime and 1 per cent. sodium sulphide is made up with that pit. Pack No. 2 is transferred to A. Pack No. 3 is put into C, once used. Pack No. 4 enters pit B, twice used.

Fifth day. Pack No. 2 is removed. Pack No. 4 is drawn from B, and a new liquor is prepared as above. Pack No. 3 is transferred to B. Pack No. 4 is transferred to A, once used. Pack No. 5 is put into C, twice used.

Sixth day. Pack No. 3 is removed. Pack No. 5 is drawn from C, and new liquor prepared. Pack No. 4 is transferred to C. Pack No. 5 is put into B, once used. Pack No. 6 is transferred to A, used twice.

When once started, the above described movement can be carried out and entails only a small amount of handling of the stock. This method gives a good grain and full feel. On removing the hides from the lime liquor they should be

thrown into water at 85° F. for one-half hour, then unhaired on the machine or over the beam. The next process is bating.

Sodium Sulphide Process for Dry Hides.—The immersion of hides in a solution of sodium sulphide removes the hair quickly, freshens the grain and imparts great toughness to the leather. For heavy chrome leather for winter and work shoes this is an excellent process. The hides should be split into sides, fleshed, and put into cold water over night.

The unhairing solution is prepared in the following manner: Put 200 lbs. of sodium sulphide into a barrel two-thirds full of water. Turn on steam and boil slowly until the sulphide is dissolved. Let the solution stand until the foreign matter has settled to the bottom of the barrel and the liquor is cold, which requires twelve hours, or over night. Only the clear solution should be used, the settlings being thrown away.

Put enough water to cover the sides into a vat; add to it enough of the solution of sulphide to make a six or seven degree liquor. The exact strength, however, is immaterial; the stronger the liquor is the sooner the hair is dissolved; but a good rule to follow is to start with a liquor of six degrees, which requires about three days to accomplish the desired result. Put the sides opened out well, into the liquor, and let them remain twenty-four hours; then haul them out. Plunge the liquor up and put the sides back twenty-four hours longer; then haul them out again.

Plunge the liquor again and put the sides back for another twenty-four hours. At the end of the third day the hair should have been reduced to a slimy mass, which can be easily washed off, leaving the hides clean. Put the hides into a wash wheel with running water and wash them clean. If there is any hair that does not come off, the sides should be worked on a beam; and if this does not remove the hair add some fresh sulphide solution to the liquor and put the hides back into it for another twenty-four hours. After the washing has been accomplished, the hides are limed.

Slake ½ bushel of lime for each 100 sides in the pack. Add

the slaked lime to water in a pit, put the unhaired hides into the liquor and keep them in the same two or three days, handling them each day. A little more lime may be used to make a softer leather. After the sides have been thus limed, wash them in cold water and then split them into grains and splits, and bate and pickle them. It is advisable to split out of lime and to tan the grains with a two-bath process, which splits up the hide fibers and makes softer leather than the one-bath process.

This process destroys the hair but makes plump and tough leather. The workmen who handle the hides through the sulphide process must wear rubber gloves to protect their hands from the caustic material. When hides are split out of the lime, the grains are bated, pickled and tanned; if they are split out of pickle or after tanning, they are bated and pickled whole. Opinions differ in regard to the best time for splitting. The author considers splitting out of alumina and salt pickle the best procedure for chrome leather, but some good tanners split out of acid pickle and others out of lime.

The condition of the flanks and the fineness of the grain depend largely upon how the grains are bated and delimed.

Notes on Beamhouse Work.—In the process of liming hides for sole leather and other kinds of firm and solid leather, much depends upon the condition of the lime liquors. A new lime has great swelling and plumping, but little solvent, effect upon the hides. Such a lime, particularly if caustic soda is added to it, is strongly antiseptic. A short liming in new, sharp liquors is desirable in order that but little hide substance may be dissolved. The plumping effect of such a lime is very great, while an old lime liquor has a more solvent effect and does not plump the hides so well. Caustic soda in the lime liquor assists in getting the full plumping effect, but it must be used carefully or it will cause rough grain.

Where sulphide of sodium is used in the lime liquors the unhairing is hastened and the plumping effect of the lime increased, but unless the sulphide is used rather sparingly the grain is liable to be coarse. An old lime liquor containing

considerable sulphide makes leather more pliable than a clear, fresh lime liquor. An old lime dissolves hide substance, which means pliable leather, but the swelling effect of such a lime is less than that of a new lime. For sole leather, therefore, liming should be done in new liquors to get the full plumping effect and to avoid the loss of hide substance.

If pliability is an essential in the leather, the best procedure is to place the hides first in an old lime to get the softening, and least solvent, effect, and then to place them in a fresh lime where they will be plumped. The more mellow the lime liquors are the greater the flexibility of the leather.

For some leathers, such as harness and belting stock, fairly fresh limes containing sulphide of sodium should be used. Such limes accomplish the swelling and unhairing rapidly, but do not dissolve enough substance to make the requisite degree of flexibility, and it is therefore advantageous to accomplish the latter effect in the bates. Bacterial bates dissolve considerable substance, and where pliability is wanted such bates should be used, especially when liming has been done in fresh limes.

Soft leather is obtained by somewhat long liming in mellow limes followed by thorough bating and rather heavy pickling, and this is the usual process for upper shoe leather, glove leather, etc. For leather that is to be finished dull, sulphide of sodium is preferable in the limes; for leather that is to be given a fine, glazed finish, red arsenic produces the best results.

Arsenic limes have a characteristic action which is due to the calcium sulphydrate which forms when red arsenic is added to slaking lime. Sulphide of sodium should be dissolved separately and added to the lime, but red arsenic should be mixed with the dry lime and slaked with it, or else added to the lime while it is slaking. Lime should in every case be thoroughly slaked and stirred before it is used. Unslaked lumps should never be allowed to pass into the lime liquor since they are liable to burn the hides. Caustic soda may be added direct to the lime liquor. Its use can be

recommended for heavy leather as it sharpens the lime, but not for light, soft leather, the latter being benefited most by the use of sulphide of sodium or red arsenic. Caustic soda is useful in swelling and plumping the hides quite rapidly, but it does not assist in making soft leather. In an old and mellow lime there is considerable bacterial activity, and such a liquor because of its solvent effect, tends to produce a leather that is soft and loose and having a dull grain. Hides that have been passed through such a lime should therefore be put into a fresh lime to be properly swollen and plumped.

Hides can of course be rapidly swollen and unhaired by using a strong lime liquor made of equal parts of lime and sulphide of sodium, or a solution of the sulphide can be used alone; but while the rapidity of the process and the absence of any loss of substance is an advantage, the fibers are not sufficiently swollen and the grease in the hides is not saponified as it should be, the result being hard, coarse leather.

If such a process of liming is used, the hides should be placed in a weak sulphuric acid bath before they are tanned in order to further split up the fibers. Where hides are to be tanned in drums, with extracts, or by some other rapid tanning process the hide fibers should be thoroughly split up in order that the tan liquors can penetrate rapidly, this being accomplished by using fairly sharp limes and liming the hides from twelve to fifteen days. Good results are secured by placing hides for sole leather in an old lime for a day or two, next to put them into a medium or fairly strong lime for a day or two, and then to finish the process in new, sharp lime, from which the hides are thrown into warm water and unhaired a few hours later. Carbolic acid is useful in preventing bacterial action and decay in the soaks, but it is liable to impede the process of liming. It is of advantage, however, for hides that have begun to decay as it prevents further damage in the soaks. Soak vats should be disinfected from time to time, carbolic acid being quite satisfactory for this purpose.

Liming for Thin Grain.—Leather can be made with a thick or a thin grain by certain manipulations in the beamhouse.

Hides can be so treated that when they are tanned they have a thick, solid grain, this being usually done by using sulphide of sodium and unhairing the hides rapidly. On the other hand, by liming with lime alone in clean, white lime, the grain can be made soft and flexible, and so thin that when the leather is split after it is tanned, the grains have considerable substance and strength even when the hides are split unusually thin.

By shaving the hides green, liming them for eight days, bating them until they are soft and low, and by stirring them easily in the tan liquors, a thin grain is obtained. A process of accomplishing this result is carried out as follows: First, the hides are soaked in clean water twenty-four hours; they are then fleshed and resoaked twelve hours longer, drained and passed into the first lime. This lime is prepared by using 1 lb. of lime in sufficient water for 100 lbs. of hides. The hides remain in this lime twenty-four hours and are then hauled out and the lime is strengthened by adding another pound of lime. The hides are put back for twenty-four hours longer, then hauled out and put into the second pit. The third lime liquor should contain 2 lbs. of fresh-slaked lime for each 100 lbs. of hides in the pack. At the end of twenty-four hours the hides should be hauled out and placed in the third lime, prepared the same way as the second lime. Twenty-four hours later the hides should go into the fourth lime, which should be a little stronger with lime than the preceding liquor. At the end of eight or nine days the hides should be in condition to be unhaired. After they have been unhaired, put them into water warmed to 85° F. for six or seven hours; then work them over the beam by hand and get them as clean as possible. After this, fine-hair them, reflesh them on the machine and then bate them.

As the hides are to be tanned in vegetable tanning liquors and split, a depleting bate should be used that not only removes the lime but also makes the hides soft and thin and having a fine, soft grain. Bate the hides soft and low; next wash them in a drum with warm water when they will be in

condition to be tanned. They absorb the tanning material rapidly and must be handled every day for sixteen days when, under normal conditions, they should be ready to be split. Split to two-ounce leather and retan the grains with quebracho and sumac or gambier; then proceed to finish according to the kind of leather that is wanted. The above process is good for any leather that must be thin and yet tough, such as patent tipping, and yet have considerable fiber, the resulting product being fine, thin grain and tough leather. The splits make fine Goodyear stock. The patented depilatory crystals that are used with such good results upon sheepskins produce equally good results when used for unhairing hides for chrome patent leather. Piping of the grain is the most common defect in this leather, and is usually the result of improper beamhouse work. By using a weak solution of the depilatory crystals and then putting the sides into weak, clean lime liquor, the grain comes through tough and fine and free from piping. The results are not the same when sulphide of sodium is used since this material swells the hides too rapidly and makes them have coarse grain and loose fibers. The depilatory crystals do not plump the hides unduly and thus they do not affect the grain or texture, but the solution should be weak and the hides be subsequently limed for a few days. Dry hides when treated this way make better leather than when limed in the regular manner. When chrome patent leather turns out tinny it is due to insufficient liming; and when it has a pipy grain, the cause is usually improper liming. Liming in clean limes with a small percentage of sulphide of sodium in the limes, and unhairing first with depilatory crystals, and then liming for a few days in weak limes are two ways of preparing the hides to prevent piping and loose grain, and the latter method is safer than the former.

Methods of Bating.

Bating with a Mild Fermented Bate.—A mild fermentation of an acid has proved to be a most satisfactory bate and deliming process for hides that are to be tanned into soft, supple

leather by a chrome or a vegetable tannage. Excellent results as regards full flanks, good break, and fine, even grain are obtained by allowing grape sugar or common glucose to become sour and using definite portions of the same in combination with lactic acid for each pack of hides or grains.

1. The process is a simple one and is easily carried out: Dissolve 100 lbs. of grape sugar or glucose in 35 gallons of hot water in a barrel. Allow it to stand for two days in a warm temperature, when it will be completely soured. Prepare a paddle wheel with water at a temperature of 95° F., and put into it 2½ quarts of the sour sugar solution. For every 100 lbs. of stock to be bated, take 1 pint of lactic acid and put about half of it into the prepared bate in the paddle wheel before putting in the hides, and when the latter are in, add the rest of the acid. Three or four hours are usually sufficiently long to run the goods in the paddle wheel. On being taken out, they should be thoroughly washed with water. The importance of this simple washing is too often overlooked, and the necessity of it cannot be over-emphasized, if a good clear grain which will color evenly, is desired. For the second pack of hides, the bate liquor is run down about twelve inches in the paddle wheel and the loss made up with fresh water. The temperature is brought up to 95° F., 2½ quarts of the sour sugar solution being added and 1 pint of lactic acid for every 100 lbs. of stock as directed for the first pack. Continue in this way, running off a little of the liquor for each pack, for six days, then run off all the liquor, retaining however about a barrelful with which to mellow the new liquor, which is prepared with fresh water.

It should be pointed out that the amount of sugar solution used, namely, 2½ quarts per pack, is based upon the volume of liquor in the paddle wheel. The average capacity of a paddle wheel is between 2000 and 2500 lbs. of stock. The action of the sour sugar is, however, so mild that a wide range in the weight of the stock bated with the given quantity of the sugar solution is permitted without danger.

2. *Another Method.*—Another and a simpler method of

introducing the fermentation into the bate is as follows: Prepare a paddle wheel with water at a temperature of 120° F., and put into it 2 pailfuls of dry bran and allow it to stand over night. The next morning bring the temperature up to 95° F., and take 1 pint of lactic acid for every 100 lbs. of stock and put about half of it into the bate liquor. Throw the hides in and add the rest of the acid. Run the paddle for three or four hours, then take the hides out and wash them well.

For the second pack, run the bate liquor down about twelve inches and make up the loss with fresh water, and bring the temperature up to 95° F. Do not use any more bran but take 1 pint of lactic acid for every 100 lbs. of stock and proceed exactly as with the first pack. Continue in this way for six days; then run off all the bate liquor and make up a fresh liquor in the same manner as directed for the first pack.

Either of the above-described processes is very satisfactory for deliming hides for side leather of any description, uniform results being obtained with very little practice. The processes are applicable alike to unsplit sides and the grains and splits of hides split after liming.

3. Lactic acid is frequently employed by itself, a little less than 1 pint of it being used for 100 lbs. of grains that have been washed after fine-hairing. The acid is added to lukewarm water, the grains are put in and processed two or three hours; then washed, pickled and tanned. Unsplit sides should be given more acid and be left longer in the baths than the grains of split hides.

Bating with a Bacterial Bate.—Because of the thorough manner in which it rids hides of lime, leaving the grain soft and clean, without any danger of injuring the texture of the goods, oropon bate can be recommended for the grains of sides split out of lime that are to be tanned into soft chrome or vegetable-tanned leather. About 8 ozs. of the material are used for 100 lbs. of stock, in water at 100° F., the goods being turned from time to time and allowed to remain in the liquor over night. The next morning they are usually in a soft and open condition and free from lime.

The process that follows bating or deliming is called pickling, acid and salt being used; and the object of the process is to cleanse and bleach and preserve the goods so they will tan more readily and work out into softer leather than they would were they not pickled.

Pickling.—There are three acids that can be used for pickling for chrome and other soft tannages, namely, sulphuric, formic and butyric acids. When sulphuric acid is employed 2 lbs. of it together with 15 lbs. of clean salt and 20 gallons of water are used for 100 lbs. of hides, whether they are split or whole. The goods are drummed with this liquor one hour, then placed smoothly over horses to drain before they are tanned. Where a paddle wheel is used the hides are left in the pickle two or three hours. Split hides are now in condition to be tanned in any process. Whole sides can be split out of the pickle or tanned whole and then split. Splitting out of acid pickle does not produce as firm leather as splitting out of alumina and salt pickle, or as splitting after tanning. When hides are not split out of lime, which is the method to be preferred, it is advisable to either pickle them with sulphate of alumina and salt and then split them, or else to tan them unsplit and to split them after they are tanned.

For the pickling of grains that are to be tanned with quebracho or some other vegetable tanning material, formic acid is recommendable.; it being also suitable for chrome tanning. The process is the same as with the use of sulphuric acid except that instead of it a few pounds of formic acid are employed. Grains pickled in this manner tan quickly and have a nice light color, and there is less tanning material required and the grain is softer and finer and more easily colored than the grain of leather that is tanned without being pickled. Lime blast is prevented by using formic acid, but there should be considerable salt in the tan liquors. There is less danger of the grain becoming thick and harsh when formic acid is used, which is an important advantage. It is claimed for butyric acid that when used in pickling, the goods are made thicker and stronger and the grain smoother and

lighter-colored than by other methods of pickling. To pickle 100 lbs. of grains, use 2 lbs. of the acid, 12 lbs. of salt and 20 gallons of water, drumming forty minutes. The use of a drum and fresh liquor for each lot of skins is the most approved method of pickling, since the liquor can be kept of uniform strength.

The goods after having been pickled and drained are in condition to be tanned.

Methods of Splitting.

Splitting Out of Lime.—Hides to make good chrome leather should come from the unhairing machine firm and hard. If they are soft and flabby they will make poor leather, as there is nothing in chrome tanning that fills the hides or makes up for lost substance. After the hair has been removed, the sides should be washed in lukewarm water for fifteen minutes and then worked over the beam for short hair. This work is very important as it is imperative that all fine hair be gotten ridden of. And even if there are no fine hairs, working out the grain opens up the cells of the hides and makes the grain fine and clear. After this work has been done the sides should be put into cold water over night to harden for splitting. The next morning they are ready to be split. In splitting the sides, a 6-oz. grain from the machine will finish up 4½ ozs. of leather, as it loses 1½ ozs. going through the various processes. All loose ends and pieces of flesh should be trimmed from the sides before splitting is begun, so that there will be nothing to interfere with the hide feeding freely into the machine. After the sides are split they should be run in a wash wheel for a few minutes with cold water to open them up and to remove the glaze caused by the belt knife. The grains and splits are next bated.

Splitting out of Sulphate of Alumina and Salt Pickle.—Where hides are split out of pickle, a good procedure is to bate and pickle them with sulphate of alumina and salt in this manner: For every 100 lbs. of sides, unsplit and bated and washed, dissolve 4 lbs. of sulphate of alumina and 10 lbs. of common

salt in 6 gallons of boiling water, then add 6 gallons of cold water and use the liquor after it has cooled to 70° F. Drum the sides in this liquor one hour; then horse them up smoothly and let them press and drain until the next day.

Hides pickled in this manner should not be previously pickled with acid and salt. If the splitting machine has a corrugated roll, the sides can be split right off the horse. If the machine has a smooth roll, the sides should be hung up to sammy, or pressed or put out on a putting-out machine, to get them into condition for splitting. The grains should be the same thickness that the finished leather is to be, as they do not fall away like grains split from limed hides. Hides pickled with alumina and salt split just as easily as bark-tanned leather, and the splits are just as good as those taken from the limed hides. After the sides are split, the grains can be shaved while in the pickled condition and this saves putting them out for shaving after they are tanned. Both the grains and splits are then ready to be tanned.

Splitting after Tanning.—Tanning the sides in a chrome process and then splitting them is sometimes practiced. The sides are tanned in a one-bath chrome process in a paddle wheel or by suspension, and when they they are well struck through with the tan are pressed and split. The pressing removes the surplus water and makes the leather drier and firmer. After pressing, the sides should be run in a dry mill until they are opened up and ready to be split, when they should be jacked the same as bark leather and split to the thickness the finished leather is to be. After they are split, the grains are shaved and retanned.

Splitting out of Acid Pickle.—When hides are to be split in acid-pickled condition, they are allowed to drain twenty-four hours after being pickled, and are then pressed to remove surplus liquor and milled to remove the press-marks; they are then split to the required thickness. The grains can be shaved after splitting or after they are tanned.

Processes of Chrome Tanning for Side Leather.

Process for Acid-Pickled Grains.—1. When hides that are intended for chrome upper leather are split out of lime, the grains are washed, bated and pickled. The processes of tanning such grains are the same as for the grains of acid-pickled sides. A fine chrome side leather is obtained by tanning the grains in a two-bath process carried out according to the following directions: Weigh the pickled stock and for each 100 lbs. of it use 6 lbs. of bichromate of soda, 5 lbs. of salt, 3 lbs. of muriatic acid and 15 gallons of water for the first bath. Throw the grains into the drum and set the latter in motion. Pour the prepared solution through the trunnion and run the drum two hours. Horse the goods up over night to allow for complete fixation of the chrome. The next morning prepare a 10 per cent. solution of bisulphite of soda and dip the grains, one at a time, into this solution and throw them into the drum. The second bath of the process is prepared by dissolving 12 lbs. of hyposulphite of soda and adding the solution to 20 gallons of water; add to the liquor 3 lbs. of salt and 6 lbs. of muriatic acid. Drum the grains with this liquor two or three hours; then horse them up over night, and if there is no hurry for the leather, it is advisable to let it drain forty-eight hours before proceeding to neutralize, color and fat-liquor it. It is practicable to use sulphite of soda in connection with the hypo, which is quite effective in reducing the amount of sulphur developed. Some tanners do not use hyposulphite of soda or acid at all, but instead employ a solution of bisulphite of soda, 6 per cent. on the weight of the hides, to accomplish the work of the second bath, no sulphur at all being formed in this case. The quantities of chemicals mentioned produce good results in the tanning of light acid-pickled grains. Heavy grains require slightly increased quantities.

2. Good leather is also made by using 6 lbs. of bichromate of soda or potash, 2 lbs. of sulphuric acid, and 4 lbs. of salt for 100 lbs. of goods in the first bath, and 6 lbs. of bisulphate of soda in the second bath. In the first bath there should be at least 15 gallons of water, and the grains should be drummed

not less than two hours. The second bath should be made up to 15 or 20 gallons of liquor and the goods be drummed with it until the yellow color has disappeared and the leather has assumed a light blue color throughout the thickest parts.

3. Either of the processes that have been described can be carried out in a paddle wheel; or the following formula may be used: *First or chrome bath*: 6 per cent. of the weight of the goods of bichromate of potash or bichromate of soda, 5 per cent. of salt, and 3 per cent. of muriatic acid. The chrome is dissolved in boiling water and added to the water in the reel, about 65 gallons of water being used for 100 lbs. of stock. The salt and acid are added and the liquor is ready. The stock is run in the first bath for several hours, then allowed to remain at rest over night. The next morning the grains are removed from the reel, struck out and then dipped into a weak solution of hyposulphite of soda to which a little muriatic acid is added. After being dipped, the stock is thrown on a horse and allowed to remain a short time before it is placed in the second bath of the process.

The second bath is a solution of hyposulphite of soda to which muriatic acid is added, 18 lbs. of the hypo and 5 lbs. of the acid being used in 65 gallons of water for 100 lbs. of stock. When the yellow color has disappeared and the leather is of a greenish-blue color throughout, the tannage is completed and the leather is allowed to drain at least twenty-four hours, then washed and neutralized.

One-bath Chrome Processes for Acid-Pickled Stock.—1. The one-bath process of chrome tanning is generally considered safer and more economical than the two-bath process. The tanner can prepare his chrome liquor of chrome alum and soda, or of bichromate of soda and glucose, but the safest course to follow is to buy a good concentrated one-bath chrome liquor and use it according to the instructions furnished by the manufacturer.

A practical method of tanning with tanolin is as follows, the quantities given being for 100 lbs. of pickled grains: Drum the goods in a solution of 6 lbs. of salt and 8 gallons

of water for fifteen minutes. Dissolve in 2 gallons of boiling water 6 lbs. of tanolin and allow the solution to cool. One-third of the chrome solution is poured into the drum and the goods are drummed one-half hour; then another one-third is added and the drum is run another half-hour; finally the last portion is added and the goods are drummed one hour. Eight ounces of bicarbonate of soda, dissolved in a little water, are next added to the contents of the drum, and the leather is drummed for two hours; then 6 ozs. more of the soda in solution is poured into the drum and the leather drummed until it is fully tanned. When complete tannage has been accomplished, the leather should be horsed up forty-eight hours to allow for complete fixation of the chrome. The test for thorough tannage is the blue color throughout the leather; also boiling. If a piece of leather, when boiled, curls and becomes hard, the leather is not fully tanned; if it remains soft, the tannage is complete. The next process is washing and neutralizing.

2. In this process a liquor made of sulphate of alumina and sal soda is used in conjunction with the one-bath chrome liquor. For every 100 lbs. of pickled grains dissolve 4 lbs. of sulphate of alumina by boiling in 5 gallons of water, and in another vessel 4 lbs. of sal soda by boiling in 5 gallons of water. The soda solution is then poured very slowly and with constant stirring into the alumina solution, and the liquor allowed to get cold before use. The grains are put into the drum together with 10 lbs. of salt and 8 gallons of water and drummed ten minutes. The alumina-soda liquor is then poured into the drum and drumming continued for one hour. The liquor is then drained off; a few pounds of salt and 10 gallons of water are put in with the goods, and the chrome tanning is then proceeded with in the same manner as described in the preceding paragraph.

Process for Alumina-Pickled Grains.—Grains that are split from hides pickled with sulphate of alumina and salt may be tanned in the two-bath process the same as acid-pickled stock. They may also be tanned in the manner described for acid-pickled goods with one-bath chrome liquor, process No. 1.

Process for Unsplit Sides.—Sides that are not split previous to tanning are tanned most satisfactorily in one-bath chrome liquor in a vat with paddles. They are bated, washed and pickled either with acid and salt or with sulphate of alumina and salt. For every 100 gallons of water in the vat 35 lbs. of salt are put in and dissolved. The hides are then introduced and the paddles are run for half an hour. Concentrated chrome-tanned material is then dissolved in warm water until the solution stands 50° Bé. scale. When the hides have been in the salt water thirty minutes, 2 quarts of the chrome liquor are added and the paddle is run an hour. An addition of 3 quarts of the chrome solution is then made to the tan liquor and the paddle is run three hours. More chrome solution is then added, and the hides are kept in the bath until they are tanned throughout.

The tan liquor can also be made by adding 3 gallons of the concentrated chrome solution to the salt water to start with, and then adding 3 or 4 gallons more for every 100 gallons of water as the tanning proceeds. When fully tanned the hides are taken out and pressed for splitting, milled in a dry mill to open them up, jacked the same as bark-tanned leather and then split to the desired substance. The grains and splits are next put into the drum and retanned by being drummed ten minutes in a solution of salt and then for two or three hours with 4 quarts of the concentrated one-bath material. The leather is then washed and shaved.

Neutralizing and Washing.—After being tanned, the leather should be allowed to press and drain twenty-four hours before it is washed. The first washing is done in a drum with ½ lb. of bicarbonate of soda in 15 gallons of water for 100 lbs. of leather. The drum is run one-half hour, when the plugs are pulled out and the leather is then washed one-half hour with running water.

The neutralization can also be accomplished by using 1 lb. of borax in 15 gallons of water; washing in this solution one-half hour; then washing in running water another half-hour and setting-out and shaving the leather.

Chrome Tanning with Glucose, Glycerine, Steam and Saccharine Substances.

This process is designed to provide a metallic tanning of hides to produce a leather having the same capacity for finishing, working or use as bark-tanned leather, while retaining the toughness and durability of chrome-tanned stock. While this process attains its greatest utility in tanning heavy hides, it may also be used to advantage for tanning skins, and will be found to produce a high grade of uniformly tanned leather.

In practice for 100 lbs. of hides, the first bath consists of 6 lbs. of bichromate of potash or soda, 4 lbs. of alum, 4 to 6 lbs. of common salt, 10 ozs. of sulphuric acid, 20 ozs. of hydrochloric acid, and 60 gallons of water. The hides to be treated are prepared in the usual manner for tanning and allowed to soak in this bath until thoroughly impregnated with the chromic acid. This will ordinarily take from twelve to eighteen hours, depending upon their weight and thickness. The hides are then removed from the bath, set out and hung up until about three-fourths of the liquor in them has evaporated. When in this state, they are spread out and painted on both sides with a solution of glucose and packed in piles for from three to six hours to allow the glucose to soak in and become uniformly distributed throughout them. The glucose solution may contain from 15 to 50 per cent. of glucose dissolved in water.

To prevent the souring of the glucose in warm weather, use for 3 gallons of water about ½ lb. of quassia chips and ½ oz. of carbolic acid. The quassia chips are boiled with the water and the carbolic acid is added, and into this the glucose is stirred to make up the necessary strength of the solution.

After the hides have become uniformly impregnated with the chromic acid and glucose, a condition is established under which the reaction between said substances takes place to release the chromic oxide or tanning substance. This condition may be established in a number of ways, but it is preferable to use for this purpose a bath of hot grease. After the hides have been treated with the glucose solution and about one-

fourth of the moisture has evaporated, they are immersed in a bath of hot grease, the proportions of the ingredients of this bath being dependent upon the purposes for which the leather is to be used. For the production of a sole leather make up a bath as follows: 100 lbs. of stearic acid, 12½ lbs. of carnauba wax, 6¼ lbs. of vaseline, 6 lbs. of beeswax. This grease bath is reduced to a liquid and kept at a temperature of between 185° and 195° F., and the hides are suspended in it until the grease has thoroughly penetrated the thickest parts of them. This usually requires an hour or two. The effect of the hot grease is to establish a condition under which the chromic acid is thoroughly reduced and at the same time the hide is filled with grease. For sole leather the hides are then rolled and finished in the usual way. For harness leather the proportion of vaseline in the stuffing bath must be increased to make the leather as soft as wanted, say 25 lbs. of vaseline instead of 6¼ lbs. as stated above. To obtain the best results the glucose should be kept at 122° F.

Another process quite similar to the foregoing one is carried out as follows:

The hides are prepared for tanning in the usual way and then placed in a chromic acid bath until they are thoroughly permeated with the chromic acid. This bath may consist of 4 lbs. of bichromate of potash, 4 lbs. of hydrochloric acid and from 400 to 600 lbs. of water.

When thoroughly permeated with chromic acid the hide is subjected to a bath of an organic reducing agent, such as glycerine or glucose, or some other saccharine substance. The proportions of this bath may be 5 lbs. of glucose or other reducing agent to 5 lbs. of water. Allow the hide to become thoroughly saturated with this solution, which will take about thirty minutes.

The next step is to subject the hides to a bath of hot vapors, such as steam not under pressure. This may be done by hanging them in a room containing steam. A convenient method for introducing the steam is by means of pipes arranged in any suitable manner in the chamber and provided with

holes in their walls to permit the escape of the steam into the chamber. The hides are left hanging in the steam chamber until the chromic acid has been reduced. With thin stock this would take about one-half hour, and with thicker hides a proportionately longer time. The effect is to cause the chromic acid to be reduced to chrome oxide; and this effect taking place uniformly throughout the hides causes a uniform deposit of chrome oxide on the fibers and consequently a uniformly tanned leather. After the hides have undergone this step they are marketable leather, which does not need any further stuffing to make it retain its plumpness. It is suitable for such purposes as belting, upholstering and enameled goods. If greased leather is wanted, it may be stuffed in the ordinary manner.

A third process in which glycerine takes the place of glucose is as follows:

The first bath serves for impregnating the hides with chromic acid. There are various ways of doing this, a preferred method being to use a bath made of 4 lbs. of bichromate of potash and 4 lbs. of hydrochloric acid to from 400 to 600 pounds of water. This bath is sufficient for 100 lbs. of hides; or in place of it a bath of 4 lbs. of bichromate of potash, 3 lbs. of sulphuric acid and 3 lbs. of alum to the same amount of water may be used. The hides are left in this bath from twelve to forty-eight hours, in proportion to their thickness. When thoroughly saturated they are removed from the bath and hung on horses or racks to drain until one-fifth of the moisture in them has run off or evaporated. They are then slicked out and given a coat of glycerine. Apply this in its undiluted commercial form, but glycerine of a different state of purity or dilution may be employed. The amount of it used is preferably slightly in excess of that which is absorbed by the hide under treatment. The hides are then placed one upon another in flat piles and allowed to remain thus from twelve to forty-eight hours. At the end of that time the chromic acid will be thoroughly reduced, the result being a uniformly tanned leather. The hides are then washed, dried

and stuffed in the usual manner, depending upon the kind of leather that is being made. Any saccharine solution of rapid penetrating power may be used in place of glycerine, the hides remaining in the solution for twenty minutes, when they are left in flat piles for two or three days, then washed, dried and stuffed.

Hides treated by the above-described process tan into a leather that is firm and pliable and devoid of gristle or untanned portions, and the exterior of which is not brittle or liable to crack. William G. and Albert C. Roach of Cincinnati, Ohio, have patented this method of tanning, the patent having been assigned to the Cincinnati Chrome Leather Co.

Practical Methods of Dyeing Chrome Leather.

The dyeing of chrome-tanned side leather is accomplished most expeditiously and uniformly in a drum; and this method of dyeing is in general use. For the production of the shades of tan and brown that are usually in demand, acid and basic aniline dyestuffs are used. The acid colors are applied direct to the chrome leather without a mordant; the basic colors are applied upon a tannin mordant or base. Several approved methods of coloring the leather will be described.

Direct Dyeing with Acid Colors.—The leather, tanned, neutralized and washed, and shaved, is weighed, and the quantities of coloring material are based on 100 lbs. of shaved leather. The dyestuff is dissolved in boiling water and applied at a temperature of from 120° to 140° F. It is advisable to drum the leather with hot water before adding the dye liquor and to maintain the temperature as high as possible during the process. There should be about 10 gallons of the color solution. The leather, after having been drummed in 10 gallons of hot water, is in condition to receive the dye. The solution of dyestuff containing no acid is poured through the hollow axle into the revolving drum and the leather is drummed twenty minutes. The addition of 4 ozs. of ammonia to the dye bath insures good penetration of the color. At the expiration of the twenty minutes, the color solution in the drum

is acidified by the addition of a quantity of sulphuric or formic acid. A small quantity of acid is required to neutralize the ammonia, and in addition to such quantity, 2 parts by weight of formic acid or 1 part by weight of sulphuric acid for every 4 parts by weight of dyestuff are used. After the bath has been acidified the goods are drummed ten minutes longer, during which time the whole of the color becomes fixed upon the leather.

Coloring with acid dyes may be done either before or after fat-liquoring, the latter being at present the preferred method. It is beneficial to the leather to add a solution of sumac or of gambier to the dye bath at some time during the process; 2 or 3 lbs. of gambier may be used, or a decoction of 3 or 4 lbs. of sumac leaves or powder in 3 gallons of water at 125° F. The addition of this tanning liquor imparts a feeling of fullness to the leather which it otherwise would not have. In order to neutralize any acid in the leather, a solution of 4 ozs. of acetate of soda crystals per 100 lbs. of leather is added to the water in which the leather is rinsed after it has been colored.

Tannin Mordant for Basic Dyestuffs.—Coloring with basic dyes is effected by first applying a mordant of gambier, fustic or sumac and then dyeing to the shade desired with the proper dye. For 100 lbs. of leather 2 lbs. of gambier and 1 lb. of extract of fustic may be used with satisfactory results. The gambier and fustic are boiled in 4 gallons of water, and the solution is then cooled by the addition of enough cold water to make 12 gallons of liquor, which is used at 125° F., and the leather drummed in it one-half hour. Then dissolve in a pailful of hot water 4 ozs. of titanium-potassium oxalate, pour the solution into the drum and allow the latter to rotate fifteen minutes longer. The leather is thus prepared to receive any dyestuff, basic or acid, although basic colors are usually used upon such a bottom, the liquor being run out of the drum and the leather drummed with the solution of basic dye.

Three pounds of gambier without any fustic may be used in the same manner as the gambier and fustic liquor.

Mordanting with Sumac and Acid Dye.—For shades of brown, red brown and tan, a process of preparing the leather for coloring with basic dyestuff by the use of sumac, acid dye and titanium-potassium oxalate is carried out in the following manner: The quantities for 100 lbs. of leather are 2 lbs. of sumac extract, 6 ozs. of acid brown dye and 2 ozs. of the titanium salt. The sumac and the dye are dissolved separately in boiling water and the solution of dye is added to the sumac liquor, which is then strained. Enough cold water is then added to make 12 gallons of liquor. The leather is drummed with this liquor at 125° F. for twenty minutes. The titanium salt dissolved in a little hot water is poured into the drum and the drumming is continued fifteen minutes. The liquor is drained out of the drum and the leather washed in two changes of warm water when it is then ready to receive the coloring liquor. Various shades of brown and tan are obtained by combining phosphines, Havana brown and blue basic colors, the leather being drummed in the dye bath one-half hour, then drained and if not previously fat-liquored, it is next fat-liquored, oiled, dried and finished.

Mordant for Dark Tan.—A fine shade of dark tan results from the application of red fustic extract and titanium-potassium oxalate. The color can then be modified or shaded by coloring with basic or acid dyestuffs. For 100 lbs. of shaved leather use 4 lbs. of red fustic extract in solution with 12 gallons of water at 140° F., and drum one-half hour. Next add a solution of 6 ozs. of the salt of titanium to the contents of the drum, and process fifteen minutes longer. Then wash and finish the leather or dye to the exact shade wanted with basic or acid dyestuff.

A light tan shade is secured by using 2 lbs. of yellow fustic extract and 4 ozs. of titanium salt in the same manner as directed for dark tan.

Oxblood Shade.—This shade is obtained on chrome grain leather by using natural dyestuffs and titanium-potassium oxalate. For 100 lbs. of leather use: Hypernic extract, 2¼

lbs.; logwood crystals, 2 ozs.; leather red, ½ oz. Dissolve these dyestuffs in 4 gallons of boiling water. Put the leather into the drum together with 10 gallons of water at 140° F. Start the drum and pour the dye liquor in through the hollow axle. After the leather has been running in the liquor one-half hour, dissolve and add 5 ozs. of the titanium salt and continue the drumming for fifteen minutes; then wash the leather and dry it for finishing, fat-liquoring having been done before coloring.

Chocolate Brown Shade.—For 100 lbs. of grains use: Yellow fustic extract, 2¼ lbs.; hypernic extract, 10 ozs.; logwood crystals, 3 ozs.; titanium-potassium oxalate, 5 ozs. Boil the three dyestuffs in a gallon of water. Put the leather into the drum together with 10 gallons of water at 140° F.; add the solution of dyestuffs and drum one-half hour. Then dissolve and add the titanium salt and drum the leather fifteen minutes longer. Wash and dry the leather for finishing.

Red-Brown Shade.—A popular shade of red-brown is obtained by applying the following alizarine dyes in the quantities stated for 100 lbs. of leather. Alizarine brown G, 4 ozs.; alizarine yellow R extra, 4 ozs.; alizarine new yellow extra, 1 oz. Dissolve the alizarine brown G by boiling in 8 gallons of water; then add 4 gallons of cold water and use the solution at 170° F. Drum the leather in this solution fifteen minutes.

In the meantime dissolve the other dyes in 3 gallons of boiling water and pour the solution into the drum. Let the drum run fifteen minutes; then drain the liquor and fat-liquor the leather. It is also beneficial to the color to add 1 lb. of extract of fustic dissolved in hot water to the contents of the drum after the second fifteen minutes and let the drum run another quarter hour. Then dissolve and add to the contents of the drum 2 ozs. of bichromate of potash, running the drum ten minutes longer. Wash and fat-liquor the leather.

Alizarine Brown.—For 100 lbs. of leather use 12 ozs. of alizarine leather brown B, No. 9052 dissolved in 6 gallons of boiling water. Add enough water to make 10 gallons of liquor and use at 170° F. Drum the leather with the color one-half

hour. Then dissolve in 1 gallon of boiling water 1 quart of yellow fustic extract and add this solution to the contents of the drum and let the drum run fifteen minutes. Then drain off the liquor; wash and fat-liquor the leather; or if it was fat-liquored before coloring, set it out and dry it for finishing.

Dyeing Chrome Side Leather Black.

1. One of the most approved methods of dyeing chrome side leather black consists of the application of logwood and direct chrome leather black. The wet shaved leather is weighed and thrown into a drum together with 12 gallons of water at 125° F. for 100 lbs. of stock. Dissolve 1 lb. of hematin in water at 125° F.; add 1 oz. of ammonia to the solution, pour the latter into the rotating drum and drum the leather fifteen minutes. Dissolve 1½ lbs. of chrome leather black C in water at 140° F. and pour the solution into the drum. The leather is drummed fifteen minutes and may then be drained and fat-liquored, or the fat-liquor can be added to the dyebath at the end of the dyeing process, the drum being run one-half hour longer. The leather is then washed in warm water, set out, oiled with suitable oil and hung up to dry.

2. Blue flesh and black grain are obtained also in the following manner: For each 100 lbs. of shaved leather use 6 ozs. of titanium-potassium oxalate, 1½ lbs. of logwood crystals, ½ lb. of direct leather black G, 4 ozs. of sal soda. First drum the leather with a solution of 3 ozs. of the titanium salt for ten minutes; then add the solution of dyestuffs and sal soda and drum twenty minutes; finally add 3 ozs. more of the salt of titanium in solution; drum ten minutes longer; then wash and fat-liquor the leather.

3. This process also gives blue flesh and black grain. For each dozen sides, dissolve 8 ozs. of nigrosine P in hot water and drum the leather with the solution twenty minutes. Then drain off all the water and fat-liquor the leather with a suitable fat-liquor; after which black the grain on a table with logwood and titanium-potassium oxalate, applying the logwood first and then the titanium salt. When the grain

has become black, wash it, set it out, apply a coat of oil and hang the leather up to dry. All dye liquor should be gotten rid of by washing before the leather is dried for finishing.

Where leather is to be given a glazed finish it is advisable to drum it with a solution of gambier or sumac before blacking it, this treatment assisting materially in getting a satisfactory glazed finish.

Fat-Liquors for Chrome Side Leather.

The fat-liquoring of chrome-tanned grain leather may be done before coloring or blacking or immediately afterwards. The preferred method at present is to fat-liquor colored leather before it is colored and black leather after is has been dyed. The surplus water should be pressed out, and the leather run in a hot drum a few minutes before it is given the grease. Some tanners, however, in order to save labor run the fat-liquor into the exhausted dye bath at the end of the dyeing process and drum the leather one-half hour, thus saving handling the stock and graining or pressing it. The temperature of the fat-liquor may range from 120° to 150° F., and the leather should be drummed with it until it has absorbed the grease, leaving the water behind. When this has been accomplished, the leather should be placed over horses to drain twenty-four hours, before being struck out, oiled on the grain and hung up to dry. Any one of the following receipts may be used with the assurance that the results will be satisfactory.

1. A well nourished and full feeling leather is obtained by using a fat-liquor made of neatsfoot oil and sulphonated oil. Heat 10 lbs. of neatsfoot oil together with 2 ozs. of carbonate of potash to 160° F. Then add 3 lbs. of potash soap and stir the mixture thoroughly. Finally add 3 lbs. of sulphonated oil and again stir the mixture very thoroughly. Dissolve 3 lbs. of this mixture in 12 gallons of hot water and use for 100 lbs. of leather.

2. For colored or black leather that is to be glazed, use for each 100 lbs. of it: Fig or olive soap, 1 lb.; neatsfoot, cod or olive oil, 2 lbs.: moellon degras, 2 lbs.; caustic soda, 1 oz.

Boil the soap in 6 gallons of water; add the oil and boil ten minutes; turn off the steam and add the degras, stirring five minutes. Dissolve the soda in a little water and stir it into the fat-liquor, which, after 6 gallons of cold water have been added, is ready for use.

3. To make 50 gallons of excellent fat-liquor for chrome side leather use the following: Fig soap, 20 lbs.; Wyandotte Tanner's soda, 5 lbs.; French moellon degras, 100 lbs. Boil the soap in 25 gallons of water for fifteen minutes. Shut off the steam and add enough water to bring the temperature down to 140° F., then add the soda and the degras and stir for five minutes. Do not boil the liquor after adding the soda and degras, but, after stirring thoroughly, fill the barrel up with water to 50 gallons. Two gallons of this fat-liquor thinned with 6 gallons of hot water is sufficient for 100 lbs. of leather. Apply at a temperature of 130° F., and drum the leather in it forty minutes; then rinse it in warm water and place it over horses to drain.

If the leather is greasy after fat-liquoring, wash it in a drum in a solution of a few pounds of Wyandotte soda in a half-barrelful of water. This fat-liquor is good for any kind of chrome upper leather, but it must be made according to the directions or the leather will be greasy.

4. *For heavy chrome upper leather*: Soap, 1½ lbs.; tallow, 4 lbs.; German degras, 4 lbs. Boil the soap until it is dissolved, then add the other ingredients. There should be 12 gallons of fat-liquor. Use at 130° F., in the usual manner.

5. A very satisfactory fat-liquor for 100 lbs. of colored leather is made of the following ingredients: Soap, ½ lb.; olive oil, 2 lbs.; treated cod oil, 2 lbs.; birch oil, 2 ozs.; salts of tartar, 3 ozs.

Boil the soap in water until it is dissolved; next add the olive and cod oils and boil fifteen minutes; then add the birch oil and salts of tartar dissolved in a little hot water. Add water to make 12 gallons of fat-liquor and use at 130° F.

6. *For grained side leather* the following is suitable: Soap, ½ lb.; olive oil, 2 lbs.; moellon degras, 7 lbs.; strong ammonia, ½ pint.

Prepare the liquor by boiling the soap and oil; add water to make 12 gallons, and just before using add the ammonia.

7. This is a good fat-liquor for 100 lbs. of *dull-finished leather:* Fig or olive soap, 1 lb.; neatsfoot oil, 4 lbs.; degras, 2 lbs.; caustic soda, 1 oz.

Prepare this in the usual manner, adding the soda last. There should be 10 gallons of the liquor and it should be used at 130° F.

8. For leather colored with basic dyestuffs this fat-liquor is recommended: Dissolve 4 ozs. of salts of tartar in 3 gallons of hot water; then stir in 3 lbs. of French moellen degras and stir well. Add water to make 12 gallons of liquor and use at 140° F., this quantity being sufficient for 100 lbs. of leather.

9. *For 100 lbs. of heavy grain chrome leather:* Fig soap, 1 lb.; German degras, 3 lbs.; neatsfoot oil, 3 lbs.; sod oil, 3 lbs.; borax, 4 ozs. Boil the soap, degras and neatsfoot oil in 6 gallons of water for one-half hour. Then add the sod oil and borax and stir thoroughly. Add water to make 12 gallons of liquor and apply to the leather at 130° F. If the leather is greasy wash it in a warm solution of Wyandotte soda. If the fat-liquor is not fully taken up by the leather, pour into the drum 4 ozs. of salts of tartar dissolved in 3 gallons of hot water and drum fifteen minutes longer. The grain should receive a coat of cod oil or neatsfoot oil before the leather is dried.

10. Dissolve 4 lbs. of soda ash in the smallest amount of water that will dissolve it. Stir the solution into 10 gallons of water in a barrel and then turn on steam and bring the water to a boil. Mix into the boiling water 12 gallons of moellon degras and boil continuously for six hours; then add enough water to make 48 gallons of fat-liquor. For smooth glazed, boarded, and dull finished leather, black or colored, use from 2 to 2½ gallons of the liquor for 100 lbs. of leather, for boarded leather the smaller quantity and for soft, dull stock the larger quantity. A soap liquor, made by boiling fig or chip soap, may be used with the degras liquor. Any reasonable amount of soap can be used. The fat-liquor should

be stirred before and after the soap is added and enough water be used to make 10 gallons of fat-liquor for 100 lbs. of leather. When the degras liquor is used by itself and no soap is added to it, give the leather from 3 to 5 per cent. of it, thinned down with water and used at 110° F. A good way to combine degras and soap is to make a soap solution by boiling 1 lb. of soap to 1 gallon of water, making as many gallons in this way as may be required. Add to the necessary quantity of soap liquor from 2 to 3 quarts of moellon degras for 100 lbs. of leather. For boarded, glazed and dull leathers the mixture of oil and degras is most satisfactory ; for enameled leather the degras fat-liquor should be used by itself.

Finishing Chrome Side Leather.

After having been fat-liquored, the leather should be placed over horses to press and drain until the next day, and then be thoroughly struck out and oiled on the grain side. For glazed leather use 1 part neatsfoot oil and 3 parts paraffine oil, or equal parts of olive oil and paraffine oil, or treated cod oil, giving the grain a light application and then hanging the leather up to dry.

Dull-finished leather may be oiled with treated neatsfoot or cod oil, with dull morocco dressing oil, or with a mixture of neatsfoot and paraffin oils. The oil should be applied evenly over each piece of leather and it is best to warm it before using it. No oil should be put onto the flanks. After having been oiled the leather should be hung up to dry in a room having a temperature of about 80° F., and there should be a good circulation of air so that it will not dry too rapidly or have a parched appearance. When dry, it is dampened and staked. Dampening is done by putting about a dozen pieces of leather into hot water and leaving them therein for a few minutes, then packing them in a clean, dry box and covering the pile with a thick layer of wet sawdust. The next day the leather is usually in condition to be staked. After having been staked it is tacked out smoothly and allowed to dry. It is then trimmed and seasoned for finishing.

Dull Finish.—A coat of dull dressing is applied to the grain of the leather; when it is dry another coat is applied. The leather is next dried and ironed with a hot iron; then staked lightly. When well tanned and fat-liquored, the leather, finished in this manner, is soft and full and has a fine, tough grain.

The seasoning for dull finish may be made of the following ingredients: Ivory soap, 1 lb.; neatsfoot oil, 1 pint; whole flaxseed, ½ lb.; beeswax, 3 ozs.; nigrosine black, 3 ozs.; powdered aloes, 1 oz.; wood alcohol, ½ pint.

Boil the soap, oil, flaxseed and beewax one-half hour in 2 gallons of water. Cool and strain. Then add the nigrosine dissolved in 1 quart of hot water, and next the aloes dissolved in the alcohol. Stir the mixture thoroughly and it is ready to be used.

Glazed Finish.—The leather is trimmed and staked; it is then given a coat of finish and dried. The next operation is glazing. Then the leather is given another coat of finish, dried and staked, and glazed again. If the finish is satisfactory a light coat of finishing oil or a mixture of neatsfoot and paraffine oil is applied to preserve the finish. The leather not infrequently requires a third coat of finish and a third glazing to make it satisfactory.

The seasoning or finishing dressing is made of the following ingredients: Logwood crystals, 2 ozs.; whole flaxseed, 2 ozs.; nigrosine black, 2 ozs.; bichromate of potash, ½ oz.; vinette, ½ pint; blood, 1 quart; glycerine, ½ pint; crystal carbolic acid, 1 oz. Boil the flaxseed one-half hour in 1 gallon of water; strain, and then add the logwood, nigrosine and bichromate of potash. Cool down to 90° F., and add the rest of the ingredients. If there are less than 2 gallons of finish, add enough water to bring the quantity up to 2 gallons.

A bright glazed finish can also be secured by using a finish made of soap, glue, blood and coloring matter: Ivory soap, 1 lb.; frozen glue, 1 lb.; logwood crystals, 8 ozs.; nigrosine black, 8 ozs.; bichromate of potash, 1 oz.; blood, 8 quarts; carbolic acid, 4 ozs.

Boil the soap in 8 gallons of water; dissolve the glue in 8 gallons of water. When dissolved, add the soap solution to the glue solution. Dissolve the logwood, nigrosine, and bichromate of potash by boiling in 8 gallons of water. Cool the solution down to 100° F., and then add the blood. Stir thoroughly and add the carbolic acid. Use 1 quart of the glue and soap solution with 2 gallons of the blood solution. Thorough cleansing of the grain is of importance in glazed finishing. Lactic acid diluted with water is rubbed into the grain and dried. The grain is then rubbed with a clean rag, given a coat of finish, dried and glazed. Frequently two applications of the acid are necessary. Barberry juice may also be used for the purpose of cutting the grease out of the grain.

Boarded Finish.—The leather is treated the same as for smooth glazed finish. After the second glazing it is boarded from head to tail, then across from side to side and oiled lightly.

Dull English grain leather is given a coat of seasoning, dried, rolled on a heavy jack with heavy pressure, then grained and oiled heavily with a mixture of neatsfoot and paraffine oils. To obtain a sharp and regular box grain, the leather is pressed with a powerful press and sharp-cut rolls before it is boarded. Boarding and oiling are the finishing touches.

Gun-Metal Finish.—This finish is secured by giving the leather a coat of bright seasoning, drying and glazing it, then staking it. A coat of the following finish is next applied, and when it is dry, the grain is ironed and oiled off with hot oil. Gum tragacanth, 1 oz.; yellow dye, 2 oz.; seasoning for glazed finish 1 gallon.

Soak the gum tragacanth in 2 quarts of water for twenty-four hours; then stir it to form a solution. Dissolve the dye in 1 quart of water. Take 1 gallon of bright seasoning made according to the first formula and stir into it 1 quart of the gum solution; then add the solution of yellow dye, a little at a time, stirring well until the color of the finish has changed from black to green-black. If too much yellow dye is used the finish becomes too green, which is undesirable.

For Storm-grain Leather.—For chrome-tanned oil-grain or storm-grain leather this formula makes a good finish: Gelatine, ½ lb.; black nigrosine, 2 ozs.; olive oil, 1 pint; ammonia, ½ pint.

Dissolve the gelatine in 2 gallons of water; add the nigrosine and heat until gelatine and nigrosine are dissolved. Let the mixture cool, and just before it begins to thicken add the oil and ammonia, and stir thoroughly. After the leather has been seasoned and grained, oil the grain with a mixture of neatsfoot and finishing oils, applied hot. Another finish suitable for heavy grain leather is made of: Olive-green soap, ½ lb.; moellon degras, 1 quart; Irish moss, 4 ozs.; logwood crystals, 2 ozs.; nigrosine, 2 ozs.

Boil altogether in 1 gallon of water twenty minutes; cool, strain and add water to make 2 gallons of finish. Apply this dressing liberally to the leather, and when the latter is half dry roll it on a heavy jack, using heavy pressure. Then grain the leather and oil off with hot oil. The leather should be rolled while it is damp, as this treatment produces a smoother grain and a more uniform break when graining.

Finish for Colored Leather.—Ivory or Castile soap, 1½ lbs.; French gelatine, 3 ozs.; blood albumen, 3 ozs. Soak the soap in 6 quarts of water for twenty-four hours. Soak the gelatine in 1 quart of hot water and when cool mix into the soap and stir until it is dissolved. Soak the albumen over night in 2 quarts of warm water; then stir it into the soap. Take 1 quart of the finish and strain it into 6 quarts of water at 90° F.

Heavy Chrome Grain Leather.—Heavy chrome leather made from the grains of split hides and from heavy calfskins is used in the manufacture of boots and shoes for sportsmen, etc. This leather is soft and quite waterproof, due to the chrome tannage and oils used in finishing it. The colors are black, tan and chocolate. The leather is very durable and is well suited to the purposes for which it is used. Hides to be made into this leather are split out of the limes, and the grains are then bated, pickled and tanned in a one-bath chrome process.

Fat-liquoring is done in the usual manner after the leather has been washed, neutralized and shaved. Two pounds of neatsfoot oil, 2 lbs. of soap and 1½ lbs. of degras, thoroughly emulsified, make a good fat-liquor for 100 lbs. of leather. The leather is drummed with this liquor forty minutes and is then blacked by hand with logwood and striker, or with a direct chrome black. When a direct black is used it is advisable to add a small quantity of gambier to the fat-liquor or to drum the leather in the gambier liquor prior to grain, blacking. Where it is desired to color both flesh and grain the leather is drummed in the dye in the usual manner, but where the grain only is blacked the dyeing is done by hand or on a machine. Where grain blacking is effected with logwood after fat-liquoring a little ammonia is used in the logwood liquor to cut through whatever grease there may be in the grain. After having been dyed, the leather is washed, set out, hung up and partially dried. A heavy coat of oil is next applied to the grain to make it soft and waterproof. A thick fat-liquor emulsion may be used for this purpose, also sulphonated oil in concentrated form. The grains are then horsed up, grain to grain, for twenty-four hours, and then hung on hooks by the hind shanks to dry. Very little staking is necessary, particularly if the leather is staked while it is drying.

If a grained finish is wanted the leather is grained in two or three directions to give the grain that is desired, and a finish consisting of soap, oil, beeswax and water, or a dull, oily dressing is applied to the grain, which is later on brushed, oiled again, and the stock is then sorted into grades. Printing or embossing with the box grain and then boarding the leather makes a fine grain that does not readily become smooth. For the shades of dark tan and brown a mordant of gambier and fustic is used, coloring being effected with basic aniline dyes. This is done best before the leather is fat-liquored, as grease applied before coloring is apt to prevent the penetration of the color into the interior of the goods. Smooth finish is obtained by ironing or rolling the leather before the seasoning is quite

dry. Excellent colors are also obtained by using acid dyes and bisulphate of soda after the leather has been fat-liquored.

Black Chrome Oil Grain Leather.—This leather is usually made from good plump hides weighing not over 50 lbs. each, green-salted weight. Dry hides that have a good grain may also be used, being softened in a sulphide soak and unhaired with sulphide of sodium, limed and bated and tanned preferably with one-bath chrome liquor. Considerable sulphide should be used in the limes through which green-salted hides are worked, to give the desirable thick grain. Splitting is done after liming or after the sides have been tanned and pressed. In the latter case retanning with chrome liquor is necessary. Neutralizing, washing and shaving are done in the usual manner and the leather is then blacked with hematin (logwood) crystals and direct chrome black; and after it has been washed and pressed it is ready to be fat-liquored. It is best to press the leather hard and then to put it into a dry mill and mill it one-half hour. Before the fat-liquor is applied the leather should be spread on a table, grain side up, and the flanks and bellies dampened so they will not take as much grease as the rest of the leather.

The following quantities of grease in fat-liquoring are required for 100 lbs. of pressed leather: 8 lbs. of stearine, 6 lbs. of tallow, 2 lbs. of German degras and 2 lbs. of sod oil. These stuffing greases are put into a kettle and heated to 190° F. The leather is first drummed ten minutes in a hot drum; it is then given the hot grease and drummed forty-five minutes, and ten minutes with the door off; it is next piled in a box and covered up and allowed to lie over night. The next morning it is struck out on the flesh side and then on the grain side and hung up five or six hours. It is then reset on the grain side and tacked on tacking-frames to dry. In resetting it is necessary to use a setting slush so the leather will stick to the table. This is made of 3 lbs. of German degras and 3 quarts of finishing oil, melted together; then dissolve 1 lb. of soap in 1 gallon of water and stir in the degras and finishing oil. Add enough cold water to make 6 gallons of the mixture.

When dry on the frames the leather is shaved lightly on the flesh side on the shaving machine, which gives a clean back. A clean, dry and greaseless back is essential on this leather since shoes made from it are frequently unlined. The leather is trimmed and staked, then boarded from back shank to neck and from front shank to tail, thus making what is known as English grain. After it has been thus grained the leather is given two coats of finish and hung up until the finish is dry. It is then measured and grained lightly, just enough pressure being used to bring up the grain. The leather is now ready to be sorted and tied up into bundles.

Leather for Sporting Goods.—Chrome leather is used in the manufacture of sporting goods, such as punching-bags, foot-ball and baseball-glove leather. Light hides and kips work into this class of stock more profitably than larger or smaller skins. The flesh splits taken from the hides can be finished into cheap glove and mitten leather.

The hides are limed, bated and pickled in the same manner as hides for upper and glove leather. A liming in sulphide limes for a few days usually accomplishes the loosening of the hair in a satisfactory manner. Bating is next done with the sour sugar bate or the bran and lactic acid bate, and the goods are then pickled with sulphate of alumina and salt and tanned with one-bath chrome liquor. After having been washed and shaved the leather is colored and fat-liquored. The use of sulphonated oil as a fat-liquor, or a mixture of the same and neatsfoot oil is especially suitable for this soft leather. For the shades of color that are most in demand it is advisable to fat-liquor first and color afterwards.

When a simple solution of sulphonated oil is used from 4 to 6 lbs. of the material are used for 100 lbs. of leather. The oil is dissolved in 12 gallons of water at 125° F., and the leather is drummed with the solution one-half hour. It is then rinsed in clean hot water so as to remove all traces of oil from the surface. A fuller leather, however, is obtained by using a mixture of neatsfoot oil and the acid fat-liquor.

An olive-green color is often wanted; this is obtained by

using fustic and copperas. Dissolve 1½ lbs. of fustic in 12 gallons of water for one dozen sides, and drum the leather in this liquor forty minutes. Now dissolve 1 lb. of copperas in 1 gallon of water and pour a portion of the solution into the drum, running the leather fifteen minutes. If the color is not dark enough more copperas should be added until the right shade is secured. The leather should then be rinsed in three changes of water, before it is dried and finished. Another method of handling the stock is to give it an application of fat-liquor and dry it out; then to wash it back with hot water and color it.

When dry the leather is dampened and staked and tacked out to dry. It is then trimmed, restaked lightly and put into a dry drum together with 2 quarts of French chalk for one dozen skins and drummed two hours. The grain is then brushed with a soft brush and the skins are measured and sorted.

Chrome Side Glove and Mitten Leather.

Hides that are intended for glove and mitten leather should be thoroughly limed and bated in such manner that when tanned they are soft and elastic. The tanning is done most easily with one-bath liquor, the leather after tanning being allowed to drain until the next day. The stock is handled most readily when it is split after liming. Softer leather is made by not washing the leather until after it has been colored, fat-liquored and dried.

Yellow Leather.—If yellow leather is wanted the stock may be colored with gambier in the following manner: Boil 25 lbs. of gambier in 20 gallons of water; add 1 pint of muriate of tin and 3 ozs. of tin crystals; stir thoroughly and fill the barrel with water. For 50 sides use 4 pailfuls of this gambier liquor. Add to it 2 gallons of water and ½ lb. of picric acid and ½ lb. of fustic dissolved in 3 gallons of hot water. Mix the color solution in a tub and use it at 90° F. Drum the leather in it one hour.

Another and perhaps a better way is to mix 4 pailfuls of

the gambier liquor and 2 gallons of water and to drum 50 sides with the solution one hour. Then add the picric acid and fustic dissolved in 4 gallons of hot water and run the drum thirty minutes longer. Let the leather drain until the next morning, then fat-liquor it.

Yellow shade is also obtained by using fustic extract and Auramine II. For 100 lbs. of leather dissolve 2 lbs. of fustic and ½ lb. of tin crystals in 6 gallons of boiling water and increase to 10 gallons of liquor by adding water. Drum the leather in this one-half hour. Then add to the liquor in the drum 6 ozs. of Auramine II dissolved in 2 gallons of boiling water and let the drum run twenty minutes; drain the leather over night and fat-liquor it the next day.

Fat-liquor Receipt.—All the fat-liquors described from chrome shoe leather are suitable for glove leather, the following being especially good:

Olive chip soap, 12 lbs.; Glauber's salt, 3 lbs.; borax, 2 lbs.; sod oil, 5 gallons; cod oil, 3 gallons; neatsfoot oil, 1 gallon.

Boil the first three ingredients one-half hour; then add the oils and boil again several minutes, finally filling up the barrel to make 50 gallons of liquor. Use 7 lbs. of this fat-liquor for 100 lbs. of leather. Dilute it with hot water and use at 125° F., drumming the leather in it forty minutes.

After the leather has been fat-liquored, it should be struck out, oiled, hung up and dried. When dry it should be thoroughly washed with clean cold water for two hours or until it is thoroughly clean. Then hang the leather up to dry, and when dry lay it in piles for ten days before finishing it.

Finishing.—Moisten the leather and stake it; then hang it up to dry. When dry, put it into the drum with 3 or 4 quarts of soapstone to 50 sides and drum it two hours, then give it a final staking. Brushing the grain on a plush wheel gives it a smooth finish that enhances the appearance of the leather.

Glove and mitten leather may also be made by drumming the goods with lactic acid after they have been washed and shaved and drying them out; then snuffing the grain on an

emery wheel and wetting the leather back, coloring and fat-liquoring in the usual manner. Shades of light and dark tan are obtained by coloring with fustic and titanium-potassium oxalate as has been already described.

Chrome Bag and Belt Leathers.

Black chrome leather with a printed or boarded grain is used to some extent in the manufacture of handbags and traveling bags and belts for personal use. The leather, when it is suitably fat-liquored and finished, is well suited to these purposes as it is soft, durable and waterproof. It must, however, be firm, clean and free from grease. The sides are tanned in the same manner as for shoe leather, preferably in the one-bath process, but the leather is given less fat-liquor. It is desirable that the color penetrate through the flesh so that the edges will be black and not blue. Direct blacks are preferable to logwood for the dyeing. The leather is fat-liquored and then dyed, or it may be first run in a solution of the dye to stain the flesh, then fat-liquored and dyed upon the grain by hand. The use of a direct chrome black with logwood dyes a rich color and gives a fuller feel to the leather than the direct black alone. It is also practicable to fat-liquor the leather while it is being dyed, drumming it first in the dye liquor and then with hot fat-liquor. The fat-liquor may be a solution of sulphonated oil or a mixture of such oil and neats-foot oil. Getting the leather too soft and greasy must be carefully guarded against. When it is greasy the grease strikes through the linings and is easily perceptible. The leather must be fat-liquored just enough to make it supple without being soft and stretchy.

The grain is boarded two ways or printed with a box grain and then boarded. Belts made of this material are almost indestructible, and bags give excellent satisfaction as regards appearance and wear. The more novel the leather is made to appear the more it is liked, there being an unceasing call for new things in these lines of leather goods.

Chrome-tanned Sole Leather.

The following method of manufacturing chrome sole leather is chiefly remarkable for its simplicity in practice, and calls for no great scientific or chemical knowledge. The raw stock is first graded, with the object of securing a uniform system of treatment for every hide. In each pack there should be no greater variation of weight than 10 lbs. This is a very important point, being one of the secrets of the successful production of this class of leather.

Soaking.—Five days are allowed for this process. After splitting the hides down the back, they are attached side to side by tying with a rope and are put into soak No. 1, usually a stale one. On the second day they are reeled forward to No. 2 soak, reeling over each day to the fourth, when they are hauled up for a rough skiving on the flesh by machine. The thick necks are also split at this stage, producing a by-product tanned for chrome splits. The sides are then returned to a clean soak for another day, when they should be thoroughly softened and cleaned.

Liming.—The following day the sides are put into a lime liquor, going from pit to pit for the period of five days. In lime No. 1, 2 lbs. of lime are used for 100 lbs. of hides. Lime No. 2 receives 2 lbs. of lime and ½ lb. of sodium sulphide; lime No. 3, 1½ lbs. of lime and 1 lb. of sodium sulphide; lime No. 4, 2 lbs. of lime and 1 pailful of diluted, dissolved sulphur. Coming from lime No. 4, the hides are hauled into a pit of lukewarm water for twenty-four hours. Each lime is run away every fourth week and started new with 6 lbs. of lime per 100 lbs. of hides. Coming from the water pit, the hides are unhaired and fleshed by machine.

Deliming.—Before scudding or fine-hairing, the goods are paddled in lukewarm water for ten minutes, then cleared of loose flesh and fine-haired. After this operation the weight of the hides is ascertained and they are again paddled in cold water for a few minutes, then removed and suspended in a pit of cold water until the next morning. Neither acid nor bate is used at this stage, nothing but pure, clean water.

Pickling.—On the following day the sides are taken to the pickling wheel. For every 1200 lbs. of hides, take 10 per cent. salt and 2 per cent. sulphuric acid, and put in just sufficient water to allow the goods to move freely in the paddle wheel, running the same until by taking a knife and securing a crosscut from the butt, there remains a thin amber line, soft and almost transparent. To get this effect a run of one, two or three hours may be necessary ; it depends upon the stock and the age of the pickling solution. This becomes rancid and should be run off once every week. On leaving the pickle, the sides are spread out in a smooth pile to avoid creases, and allowed to remain until the next day.

Tanning.—The sides are now tacked on sticks and suspended in liquors made up of tanolin, a commercial chrome crystal. This process is carried out in five or six days, the liquor and hides being moved periodically by means of mechanical rockers. The original liquor may be started on a basis of 10 per cent. of the chrome crystals dissolved in the volume of water contained in each vat, bringing the liquor up to about 8° Bé. The supplementary liquor for each pack is 2 per cent. of salt on the hide weight, added the day the sides are put into the vat. The liquor is plunged up and the sides are suspended in it. On the second day 6 per cent. of tanolin is boiled in quantities of 35 lbs., this being usually one pailful, well stirred and dissolved. It may then be poured into the vat in four portions at intervals of half an hour, the rockers being allowed to run for another hour after the last portion of chrome liquor has been added. The goods should be tanned in five days. At the end of the fourth day a crosscut should be obtained, when, if sufficiently tanned, the hides may receive ¼ per cent. bichromate of soda, dissolved and poured on the surface of the liquor in the vat. If the cutting shows incomplete tannage and unsatisfactory color, the liquor may be made lukewarm by means of a steam pipe boxed inside, the steam being circulated through the vat while the rockers are in motion. When the desired temperature is obtained the soda may be added, and the liquor agitated one hour. In

either case the addition of bichromate of soda causes a foam, denoting the acidity of the liquor. It is seldom beneficial to heat the liquor, for although it may hasten the tanning process and help the color, it reduces the substance of the finished product, and is therefore resorted to only in an emergency.

The sides may now be removed from the vat and laid out in a pile, grain exposed to the air, for at least an hour before washing, this being effected in the wheel or drum. A good, plentiful supply of clean water is needed at this stage, for it makes all the difference between a poorly finished and a cleanly finished product. Three or four hours are usually necessary for each wash, when the sides are taken out and spread over a horse to drip for a few hours. After tacking them on frames without stretching the hides are dried, and are then well rolled. For waterproof sole leather, the leather is partly dried and then undergoes a process ot fat-liquoring and filling. For this process the method is to dissolve for each 100 lbs. of leather, squeezed or semi-dry weight, 2 lbs. of white soap and 1 lb. of neatsfoot oil in 6 gallons of water. This liquor may be used at 125° F., and the leather drummed in it forty-five minutes. On removing from the fat-liquor, the sides may be set out on the table or by machine, tacked on frames and dried out. The filling may consist of stearine, paraffine-wax, glucose or other similar substances, mixed in different proportions for various requirements. This filling process improves the impermeability, tightness and firmness of the leather.

Another Tanning Process.—There are other methods of pickling and tanning hides for chrome sole leather. One consists of pickling with sulphate of alumina and salt, and tanning in vats, and another of pickling with sulphuric acid and salt, and tanning in pits or rocker vats.

When the hides are pickled with sulphate of alumina and salt, 6 lbs. of the former and 18 lbs. of the latter dissolved in 15 gallons of water are used for each 100 lbs. of hides in the pack. The liquor should be cold when used and the hides be drummed in it two or three hours. They are then drained twenty-four hours and either hung up and dried, dampened

and tanned, or put at once into the tanning liquor. The better process is to hang them up to dry after draining twelve hours, since this makes firmer and more solid leather. When dry they are dampened and made soft and pliable in a tub of warm water, then drummed in cold water for fifteen minutes, which puts them into condition to be tanned.

The tanning is accomplished by suspending the hides in the chrome liquor, starting with weak liquor and gradually strengthening it until the tannage is complete. The leather is then neutralized and washed the same as chrome upper leather and pressed and given a light fat-liquor of 2 lbs. of soap and 1 lb. of neatsfoot or cod oil in 12 gallons of water at 150° F. for 100 lbs. of leather; it is then set out hard and tacked in frames to dry. When perfectly dry it is filled with waterproof filling, this being very important in finishing and making it waterproof and durable. Tanners can buy a prepared filling with directions for its use.

Chrome sole leather is also given weight and filling after it is tanned by being drummed with quebracho extract. It is claimed that 7 to 8 lbs. of quebracho liquor, 70° barkometer, for each side of leather should be drummed into the latter after the chrome tanning is completed. Leather treated in this manner resembles vegetable-tanned sole leather in appearance, repels moisture, wears well and can be sold by the pound the same as the older tannage. This combination process takes about thirty days from the raw hide to the finished product.

A Process for Rendering Chrome Sole Leather Waterproof.— The following description relates to a German method of treating chrome sole leather so as to make it firm and resistant to water, the impregnation of the leather with the waterproofing compound being effected in the following manner: The best chrome glue is soaked in water until it has a syrupy consistence, and an equal quantity of glycerine is then added. This mixture keeps for a long time and is the basis-material for impregnating the leather. Ten parts of this composition are melted, and 70 parts of water heated to 120° F. are

poured over it. When the material is completely dissolved 7 parts of a solution consisting of 16.6 parts of 40 per cent formaldehyde, 41.4 parts of glycerine and 42 parts of water are added, stirring constantly. The liquor thus prepared is now placed together with the leather in a drum and turned, the leather being first brought to a temperature of from 160° to 190° F. Under these conditions the drumming proceeds rapidly, so that in fifteen minutes the leather is saturated with the material. When the turning is finished, the leather is piled up and allowed to lay for about twelve hours when the material will have gradually hardened. To obtain a firm and insoluble union of the fibers of the leather, the hides are subject to a high pressure between polished plates, which can be heated, so that during the pressing the leather can be kept at from 160° to 190° F. Under the effect of this temperature the impregnating material is completely coagulated and the pressure unites it firmly with the fibers. The leather is now submitted to a gradual drying process, and is ready for working up when it maintains a constant dry weight at a temperature of 85° F.

The leather can be used for many purposes; but for soles it is well to further treat it with a composition of 60 per cent. wool-grease, 10 per cent. asphalt, 25 per cent. soft pitch, and 5 per cent. gutta-percha. These ingredients are melted in a suitable vessel and kept for some time at a temperature of about 200° F. The leather is immersed in this preparation and under the action of a vacuum is quickly impregnated, forming a chrome leather, which for firmness, suppleness and resistance to water is remarkable.

Chrome-tanned Harness Leather.

In the handling of hides for chrome harness leather, the methods of unhairing and bating should be such as not to deplete them, and to preserve the strength of the fibers. In order to get heavy leather, heavy hides must be used, weighing from 60 to 80 lbs. each, and they must be plump, since there is no way of plumping chrome leather.

The hides are trimmed and hung in cold water to soak. After soaking twenty-four hours, they are split into sides, put back into the water and soaked twenty-four hours longer; when they are fleshed and soaked over night in fresh water. Splitting into sides and fleshing may be done after the hides have soaked forty-eight hours; they are then resoaked over night to be made as soft and clean as possible.

Liming.—The sides are next toggled together in a long chain and put into the first lime. For 100 lbs. of them 2 lbs. of lime, well slaked in sufficient water constitutes the first lime, the hides remaining in this twenty-four hours, when they are reeled into the second lime. The latter should contain 2 lbs. of lime and 1½ lbs. of sodium sulphide for 100 lbs. of hides. The lime should be slaked with hot water and the sodium sulphide, dissolved separately, mixed with it. The lime and sulphide are added to water in vat No. 2, and the sides reeled into the liquor and left therein twenty-four hours. The third lime should contain the same quantities of lime and sulphide as the second, and the hides are left in it twenty-four hours. The fourth lime should contain 2 per cent. of the weight of the hides of lime, the hides remaining in it twenty-four hours, when they are passed into clean warm water, from which, after three or four hours, they are unhaired on the unhairing machine. After the hair has been removed, the hides should be washed with running water for fifteen minutes, then put into clean warm water for two hours, after which they are fine-haired and worked on the grain. Thorough working-out of the grain is necessary to insure clear, tough grain that will not crack.

Bating. — This may be done with lactic acid or with any other suitable chrome bate, the bacterial bates, however, producing finer-grained leather than any acid deliming process.

Pickling.—For this process a paddle vat is used. To each 100 gallons of water in the vat 30 lbs. of salt are added, and to this liquor, for each 100 lbs. of hides, 2 lbs. of sulphuric acid and 15 lbs. of salt. For succeeding packs 15 lbs. of salt and 1½ lbs. of acid are used, 30 lbs. of salt being taken only for the first pack.

The paddle should be run for one hour, then allowed to rest two hours, then run one-half hour, and the hides left in the liquor over night. The next morning they are removed and placed in piles for twenty-four hours; they are then put into the tan liquor.

Tanning.—A good way to tan the hides so as to get full flanks and bellies and a fine, smooth grain is by the use of rocker vats. For every 100 gallons of water in the vat 35 lbs. of salt are used, and after plunging the water, 1 gallon of chrome liquor is added. The hides are hung in the liquor and rocked six hours; another gallon of the tan liquor is now added, and the hides are rocked two hours and then left until the next day. One gallon more of the tan liquor is then added and the hides are rocked six hours. Another gallon of tan liquor is then added, the hides are rocked one hour and then left at rest until the next day, when another gallon of chrome material is added to the liquor, making 5 gallons in all. The hides are then rocked four or five hours. Four ounces of borax dissolved in hot water, for each 100 lbs. of hides, are added to the tan liquor, the rocker being run one hour and then allowed to rest until the next morning. On the fourth, fifth, sixth and seventh days the hides are rocked two hours in the morning and two hours in the afternoon. The test for tannage is boiling a piece of the thickest hide. If it remains soft the hides are tanned; if it becomes hard and curls up they are not fully tanned and must be left in longer and the liquor should be strengthened.

When fully tanned the leather is put down in smooth piles for forty-eight hours. It is next washed for half an hour in water to which 1 lb. of borax has been added for each 100 lbs. of leather, and then for one hour in cold running water.

Another practical mode of tanning consists of pickling the hides with sulphate of alumina and salt, then drying them, dampening and softening with warm water, and finally tanning by hanging them in chrome liquor. This process produces well-tanned leather.

Retanning.—After being tanned and washed, the leather is

retanned with quebracho extract or with gambier, preferably with the former. For each average side from 1 to 2 lbs. of solid quebracho extract is used. It is dissolved in boiling water, enough water being then added to make 15 gallons of liquor for each 100 lbs. of leather. The sides are run in the liquor one hour, then placed in piles until the next day, when they are either pressed or put through a wringer. If pressed they should be run in a dry mill, for fifteen minutes to remove the press marks. The leather is then shaved just enough to remove the flesh and make the backs smooth and clean. When gambier is used, the quantity is about 4 lbs. for 100 lbs. of leather; otherwise the process is the same as with quebracho.

Blacking and Stuffing.—The leather, retanned and shaved, is in condition to be blacked and stuffed. There are two courses that may be pursued. The leather may be blacked and then stuffed, or it may be first stuffed, then dried, buffed and bleached. Both methods will be described.

When the leather is blacked first and then stuffed, it is taken, a side at a time, slicked out smooth on a table and blacked with logwood liquor and striker, then it is washed and run through a wringer and put into condition for striking.

The logwood liquor is made of 6 lbs. of logwood crystals and 2 lbs. of borax in 50 gallons of water. The striker is made of 7 lbs. of copperas and 5 lbs. of blue vitriol in 50 gallons of water, although any other good striker may be used. The leather after it has been wrung, is ready to be stuffed, 100 lbs. of it requiring 10 lbs. of hardwax, 10 lbs. of best stearine and 5 lbs. of good hard grease. The materials should be boiled and thoroughly mixed and applied hot to the leather in a warm drum. The leather is drummed forty minutes, then placed in piles, covered up and left until the next day. It is then struck out on the flesh side, hung up until partly dry and next stoned out on the grain. The grain is then given a light coat of cod oil and again gone over with the stone and slicker. The leather is than hung up to dry. If it is to be stuffed after shaving and blacked later on, it should

previous to stuffing be hung up and dried until it is about three-fourths dry. The bellies and flanks should have more moisture in them than the rest of the side.

The stuffing described above may be used, or a mixture of stearine, tallow and wax. The latter is made of 60 per cent. stearine, 20 per cent. tallow and 20 per cent. hardwax, heated to 190° F.; of this mixture 24 lbs. are used for 100 lbs. of leather. The leather is weighed and run a few minutes in the hot drum. The stuffing is then thrown in and the drum run forty-five minutes. After laying in a covered pile over night, the leather is struck out on flesh and grain and hung up to dry. When it is partly dry, the grain is reset, and the leather is then thoroughly dried. When dry, the scratches and imperfections can be buffed from the grain, and it is then ready to be blacked with logwood and striker. A sig to prepare the leather for the logwood is necessary. When blacked the leather is washed off, slicked and hung up to dry.

Finishing is done with mutton tallow and cod oil, 3 lbs. of the former and 2 lbs. of the latter being melted together, and the grain is given a good coat of the mixture, which is thoroughly glassed in. The leather is then left in a pile for twenty-four hours, when it is reglassed, this being the finishing touch.

In case a dry feel is wanted on the leather, the sides are seasoned with a solution of blood albumen, isinglass and nigrosine in logwood liquor, then dried and oiled off with hot paraffine oil or with a mixture of paraffine and neatsfoot oils. Sometimes a coat of starch decoction is applied to the flesh side.

By using 7 lbs. of quebracho liquor, 70° barkometer, for each side, weight and solidity are given the leather. Chrome-tanned harness leather made by the methods that have been described has greater tensile strength and is more waterproof than ordinary bark-tanned leather.

Chrome-tanned Belt and Strap Leathers.

Hides for these two classes of leather are treated in the

beamhouse in the same manner as those for chrome harness and sole leathers. For belting leather, however, they are trimmed into butts after liming or after bating. The butts should each be about 4½ feet long and 4 feet wide, though some may have a width of 4½ feet. The bellies and heads are tanned with extract and sold as offal. The butts are then tanned with chrome liquor in a drum or in a vat. Tanning in a drum is effected by pickling the butts and tanning them with one-bath chrome liquor according to the procedure outlined for chrome upper leather. When a vat is used the process is the same as for harness and sole leathers.

After having been tanned and washed, the butts are fat-liquored with soap, oil and degras, 1 lbs. of soap, 5 lbs. of degras and 2 lbs. of neatsfoot oil boiled an hour in water, to which 6 ozs. of borax have been added, being sufficient for 100 lbs. of leather. There should be 12 gallons of fat-liquor. The butts are first run in a drum together with 12 gallons of water at 160° F., and 4 ozs. of salts of tartar for each 100 lbs. of leather. The water is then drained off and after the fat-liquor, warmed to 140° F., has been put in, the leather is run in it forty-five minutes. It is then placed in piles for twenty-four hours when it is taken and set out good and hard. The grain is oiled with cod oil and the butts are then hung up to dry. The next operation is stretching, the object of this being to get all the stretch out of the leather. The butts are soaked in hot water and piled down over night. The next day they are stretched in belt stretchers as tightly as possible and allowed to get thoroughly dry; they are then finished and ready for cutting up into belts.

Good leather is also made by fat-liquoring the butts with a solution of soap, drying and dampening them and then stuffing them with German degras, paraffine and paraffine oil. Drying and stretching are effected in the manner that has been described. A satisfactory stuffing mixture is made of 4 lbs. of cod oil, 2 lbs. of black degras and 6 lbs. of stearine for 100 lbs. of leather. No soap is used with this stuffing, which is applied at a temperature of 165° F.; the butts are then dried and finished.

The trimmings taken from chrome belts may be retanned with hemlock or oak liquor and sold as trimmings from oak belts. They are first drummed in hot salt solution, next given a light retan with hemlock extract and then laid away in strong hemlock or oak liquor, preferably the latter, until they are colored throughout, when they are dried and sold.

Strap Leather.—There are numerous uses for which soft strap leather is suitable. The beamhouse treatment and the tanning are the same as for chrome harness leather. When tanned the leather is washed, shaved, and fat-liquored with 4 lbs. of moellen degras, 2 lbs. of cod oil, 2 lbs. of wool grease, 1 lb. of soap, and 7 ozs. of alkali, boiled and made into an emulsion with 12 gallons of water for 100 lbs. of leather.

After the leather has been drummed in this fat-liquor forty minutes, the liquor is drained off, and the leather washed in warm water containing 1 pint of ammonia in 10 gallons of water. This water is drained off at the end of ten minutes, and the leather is then retanned with gambier, 4 lbs. of it dissolved in 15 gallons of water being used for 100 lbs. of stock. The leather is drummed with this liquor one hour; it is then set out on the grain and hung up to dry. Any rough spots can be buffed off before the leather is finished.

The finish is made by boiling 8 ozs. of Irish moss, 8 ozs. of starch, 8 ozs. of soap, and 1 pint of olive oil in 4 gallons of water for thirty minutes. When cool, the solution is strained and enough water added to make 8 gallons of finish. The leather is given a coat of this finish, staked on the flesh side, rolled and hung up to dry or tacked in frames. It should be rolled immediately after staking and before it is dried. When dry it is given a second coat of finish, dried and rolled again. This process makes very tough, pliable and durable leather that outwears the best bark-tanned product made.

Chrome Leather from India-tanned Kips.

India-tanned kips, when carefully retanned with chrome liquor, make serviceable leather that partakes of the nature of both vegetable and chrome tannages. A few suggestions relative to retanning and finishing this leather will be given.

The kips are first soaked in warm water and placed in piles to soften. When the water has penetrated the hides, they are run in a drum for a quarter of an hour to further soften them and to remove the dirt and plaster adhering to them, warm water being used for this washing. The hides are next cut down the back into sides for more convenient handling, and are then split on the belt-knife machine. As the hides are not fully tanned, a great deal of care is necessary in splitting in order to prevent cutting and gouging. The knife must be kept in perfect condition, and the hides should be neither too wet nor too dry or they will split very unevenly. All the rough flesh around the edges and shoulders should be trimmed off before the hides are washed and stripped of the tannage. When the old tannage is not washed out, the leather finishes hard and uneven. It is only after a large portion of the vegetable tannage is removed that it is possible to produce a perfectly regular chrome tannage.

Washing is done with borax or washing soda or sal soda. From 2 to 3 lbs. of sal soda should be used for 100 lbs. of dry leather. It is dissolved in warm water, and the hides are drummed in the solution at least thirty minutes and perhaps longer if they seem to require it. The temperature of the water should be about 95° F. After the leather has been washed in the above solution for half an hour, it should be washed in warm water and made as clean as possible before it is retanned.

Borax may be employed with advantage since it acts gently and gives a smooth grain to the leather, from 2 to 3 per cent. of it of the weight of the goods being used. When the leather has a soft and slippery or semi-gelatinous feel it shows that a large proportion of the tannin has been removed, and it should be washed until this condition is reached. The liquor is then allowed to run out without stopping the drum, and tepid water is run in to wash the leather. This washing is continued until the water issuing from the drum is clear, showing that the dissolved tannin is removed. It is well to add a little sulphuric acid, ¼ or ½ per cent. of the drained

weight of the goods, to neutralize the acid retained by the leather. After another washing with clear water the goods are ready for the chrome liquor. Any good one-bath material may be used. The washed hides, after draining, are put into a drum together with sufficient water to cover them, and a few pounds of salt are added and dissolved. The drum is started and the chrome liquor poured in through the hollow axle. The liquor should be added in three portions, the first one after the hides have been drumming in the salt water a few minutes, the second one after fifteen minutes, and the third one thirty minutes after the first portion, and the drumming should be continued from one to two hours. The leather is then allowed to drain twenty-four hours. Neutralization, washing, fat-liquoring and dyeing then follow in the usual order, the same materials as upon regular chrome leather being used.

Finishing is done as upon chrome upper leather. The grain is seasoned, dried and glazed. If grained leather is wanted, the leather after the first glazing is grained in two ways from neck to butt and from side to side. A light coat of seasoning is then put on, and the leather is reglazed and re-grained. When finished it resembles very closely genuine chrome-tanned leather.

Patent Tipping from India-tanned Kips.—India-tanned kips, when properly retanned and fat-liquored, make a good grade of patent tipping leather. The kips are taken from the bale and split into sides, and are then dampened and placed in piles until the next day. The grain is then split off at a $2\frac{1}{2}$ or 3 ozs. weight. Washing to prepare the grains for retanning is the next process. It is done with water at 85° F., the leather being washed in it in a drum for forty minutes, then drained and put into the retanning liquor.

Gambier and hemlock make a good retannage. Prepare a 20° barkometer liquor and use 3 gallons of the same for every dozen sides. Drum the leather in this for thirty minutes. Next place the goods in a pile until the next day, then hang them up to dry. When dry degrease them for the purpose of removing the peculiar grease in the leather that cannot be got

rid of by washing and that makes it impossible to japan the leather when it is left in.

For a fat-liquor use good moellon degras. Add 3 or 4 ozs. of salts of tartar to 3 gallons of hot water at 125° F., then stir in 3 lbs. of degras. Stir thoroughly and drum the leather with the fat-liquor thirty minutes. This quantity of liquor is for 50 sides. After fat-liquoring, set the leather out on the grain and tack it on frames to dry. When dry, buff off the grain and stake lightly, and it is then ready to be japanned. If no fat-liquor is given, the leather will be dry and tender. There is no danger in using good moellon degras since all bark tipping, carriage and furniture leathers are stuffed with it.

White Side Leather.

A white leather that closely resembles alum leather is made by tanning the grains of split hides in a one-bath chrome process, and then either bleaching the leather with borax and sulphuric acid or treating it with flour, or both. The hides should be split out of lime; the grains are then bated and pickled with sulphuric acid and salt. When the leather is tanned, wash it in a fairly hot and strong solution of borax for one-half hour. Then prepare a solution of sulphuric acid and water, made by adding acid to water until the solution is as sour as a lemon. Take the leather from the borax bath and wash it in a drum in the acid bath; then wash it in clear water to remove the acid, next fat-liquor it.

Treatment with Flour.—Drumming the leather with flour is another way to make it white. The flour treatment can be used by itself or after the borax and acid process. The leather is washed after tanning and is then given the flour treatment, 50 lbs. of flour being the quantity used for from 50 to 100 sides according to size. The flour should be stirred into a thin paste with water before it is used. The leather is drummed with the flour for two hours, and is then fat-liquored.

Acid fat-liquor dissolved in hot water is the most suitable fat-liquor for this leather, from 4 to 6 lbs. of the soluble oil being sufficient for 100 lbs. of chrome leather. It is mixed

into 10 gallons of hot water and applied to the leather immediately after the treatment with flour. The leather is then dried, staked and finished.

Finishing.—After having been staked the leather is run in a closed drum together with powdered chalk or soapstone for one hour or longer; it is next staked again and is then ready for use. Properly tanned and fat-liquored, the leather finishes up very soft and white and is admirably adapted to the purpose for which it is intended.

Tanning with Sulphate of Alumina.—White leather that is suitable for various purposes is made by tanning acid-pickled grains and flesh splits with a basic solution of sulphate of alumina. Splitting is done preferably out of lime, the stock being then bated and pickled.

To prepare the tan liquor boil 12 lbs. of sulphate of alumina in 10 gallons of water; also dissolve in 1 gallon of hot water 24 ozs. of bicarbonate of soda. Pour the soda solution very slowly and with constant stirring into the alumina solution. When the two solutions are mixed let the liquor cool to 80° F. before using it.

Put the pickled stock into a drum together with 10 gallons of water, 1 lb. of Glauber's salt and 3 lbs. of common salt for 100 lbs. of stock. Drum twenty minutes, then drain off the liquor. Put into the drum 10 gallons of lukewarm water and 4 lbs. of salt, and drum the sides in this brine ten minutes. Then pour into the drum half of the alumina and soda liquor and drum the sides in it for three hours. At the end of the three hours take the stock out and place it over a horse to drain until the next day, then hang it up to dry. When dry put the leather back into the drum together with a few pailfuls of water and drum ten minutes. Then add the other half of the alumina-soda liquor and drum three hours. Horse the leather up until the next day, and then hang it up to dry.

Fat-liquoring with Acid Fat-liquor.—When dry let the leather remain in the dry condition in a clean dry room for two weeks; then dampen it with warm water preparatory to fat-liquoring. Sulphonated oil imparts the necessary softness to the leather

without discoloring it or making it greasy. For each 100 lbs. of dry leather use 7 lbs. of the oil dissolved in 10 gallons of water at 95° F. Drum the moistened leather with the solution of oil forty minutes; then let it drain over night. The next day strike out the grain and apply to it a mixture of French chalk, 2 parts of glycerine and 4 parts of water; hang the leather up to dry.

Finishing—Finishing consists simply of moistening and staking the leather and tacking it on boards. When dry and taken from the boards, if not soft enough, restake it; or if staking does not soften it sufficiently give it more fat-liquor. And if the leather does not appear to be entirely tanned it can be put back into the drum and retanned with alumina and soda liquor and then dried as before. The grain may be buffed off if desired; and the appearance of the flesh side can be improved by buffing it on an emery wheel.

If, for any reason, it is desired to retan the leather into chrome stock, it can be done by wetting the goods back and retanning with one-bath chrome liquor, coloring and finishing the same as regular chrome leather.

Chrome Velvet Leather.—The chrome-tanned sides are fat-liquored in the usual manner, some substance being added which during the subsequent dyeing isolates the fibers of the leather in such manner as to allow of it being soaked and softened without difficulty, dextrine, grape sugar, syrup, etc., being for this purpose used. The leather is then dried and buffed. In the case of grain leather either the flesh-side is buffed or the grain is ground. Flesh splits are buffed or ground on the flesh-side. The ground leather is then drummed with warm water until it has regained its original softness, and is dyed with acid dyestuffs and bisulphate of soda. During or after the dyeing a somewhat larger qnantity of gambier or sumac is added than is otherwise customary with chrome leather, in order to impart to the leather the necessary firmness. The velvet is then raised by working the leather in the dry drum after it has absorbed some moisture by a treatment with wet sawdust.

Chrome-tanned Patent Leather.

Hides intended for chrome patent leather should be carefully selected after they have been unhaired. The grain must be as nearly perfect as grain can be. Only small pattern and plump hides can be made into patent leather, as large, spready and thin hides are of loose texture when tanned. After the hair and fine hair have been removed, the hides should be washed in a wash wheel; they are then bated. Bating must be very carefully done. If the hides are bated too much the leather is loose and breaks coarse; if not bated enough, the grain is harsh and tender. A thin grain is to be preferred to a thick one. The former has more elasticity than the latter and is therefore less apt to crack. After the hides are bated they should be washed a few minutes in warm water to cleanse the grain; they are then pickled.

Pickling and Tanning.—For every 100 lbs. of hides dissolve 4 lbs. of sulphate of alumina and 10 lbs. of common salt in 6 gallons of boiling water, and to the solution add 6 gallons of cold water. Use this liquor cold and drum the hides in it one hour, then press or partly dry them for splitting. After the hides are split the grains can be shaved, and this saves putting-out for shaving after they are tanned. The grains are then ready to be tanned.

The one-bath process of tanning is to be preferred for patent leather as it gives the most measurement and there is no sulphur to cause trouble after the leather is finished. Drum the grains in salt water; then give them the tanning liquor and continue drumming until the leather is fully tanned. The leather can be washed, colored and fat-liquored in about the same manner that other chrome leather is treated; or it can be laid away for four or five days in chrome liquor. The layaway liquor is prepared by adding 5 gallons of chrome liquor to 100 gallons of water. The leather is placed in this liquor and handled each day. The object of this treatment is to make the leather softer than it would otherwise be and thereby reduce the quantity of fat-liquor required. Hides placed in a layaway liquor do not draw and shrink as much

as leather not tanned this way. After thorough washing the leather is colored and fat-liquored.

Coloring and Fat-liquoring.—Coloring is best effected with logwood (hematin) and direct chrome leather black. Fat-liquoring is done most satisfactorily with degras and soap, or with degras alone. When soap is used, a solution of it is prepared by boiling 1 lb. of soap to each gallon of water. Then for every 100 lbs. of leather 2 quarts of degras are added to enough soap liquor to drum the leather in, and the leather is drummed in such liquor forty-five minutes immediately after it has been dyed black. It is then struck out, oiled on the grain and hung up to dry in a warm room. Drying should proceed rapidly so that the leather will dry as firm as possible. Ordinarily chrome patent leather requires degreasing previous to finishing.

When degras is used without soap, the fat-liquor is made as follows: Dissolve 4 lbs. of soda ash in the smallest quantity of water that will dissolve it. Pour the solution into 10 gallons of water and bring to the boiling point. Then add 12 gallons of moellon degras and boil steadily for four or five hours; Then add enough water to make 48 gallons of fat-liquor. From 3 to 5 per cent. of the liquor based on the weight of the shaved leather is used. The leather is then oiled lightly and hung up to dry. Since a fairly rigid and firm foundation is required to prevent the parting of the varnish, the leather must not be made too soft.

Staking and Finishing.—When the leather has dried, it is dampened and staked and tacked out as tightly as possible. When taken from the frames it is usually sufficiently firm to be finished, were it not for the grease in it that must be removed. Some of the grease given in fat-liquoring, and some of the oil applied to the grain does not combine with the fibers and unless removed causes the varnish to slip over the leather, making finishing impossible. Degreasing is done most satisfactorily with naphtha. Where a large quantity of leather is being made, a naphtha plant is necessary or else the leather must be sent to a degreasing establishment and

FINISHING PATENT LEATHER.

To face page 310

degreased by those who make a business of extracting grease from leather. Degreasing can also be done by soaking the leather in naphtha for ten hours, then pressing out the naphtha and drying the leather. The action of the naphtha upon chrome leather is quite harmless; and where the leather has been well fat-liquored and oiled, no strength is lost through the degreasing operation.

Sides for patent leather can be tanned with chrome liquor and then split to the desired substance and retanned. This improves the "break" of the grain and softness of feel. Sulphide of sodium should be used with lime in preparing the hides for tanning. It gives the grain an appearance similar to coltskin, removes the fine hair and produces fuller and plumper leather than lime alone or lime and red arsenic. All fine hair must be removed as it is one of the worst things to contend with in making patent leather. Hides that weigh more than 40 lbs. each are not suitable for patent leather.

Vegetable Tanning Process for Side Leather.

In the manufacture of leather of various kinds from hides and kips that are finished upon the grain side, various processes of tanning are employed, hemlock bark and hemlock extract being used, also gambier, chestnut extract and quebracho extract and other extracts and tannin-yielding materials. Quebracho extract is largely used by itself, but it is also combined with hemlock and chestnut extracts. Hides are also not infrequently started in quebracho liquor and retanned with some combination of extracts. Gambier is one of the staple tanning materials. It makes soft and tough leather that is readily colored and finished in any desired manner. The tanning with gambier and extracts is usually done in vats that are provided with paddles by which the liquor is stirred; pits or vats in which the hides are suspended are also used. The less agitation and pounding hides are subjected to during tanning, the fuller and plumper the finished leather will be, especially in the flanks and along the sides. A common method of tanning consists of tanning the hides with hemlock

bark liquor until they are struck through, then splitting them and retanning the grains with gambier and sumac.

Tanning with Hemlock and Quebracho Extracts.—One of the best combinations of extracts that a tanner can use is a mixture of quebracho extract and hemlock liquors. Hemlock is a rather harsh tannage when used by itself, and quebracho is therefore frequently used with it, the result being soft, pliable leather and good color. Quebracho also hastens the tanning and reduces the cost.

The hides are limed, bated and washed, and are then subjected to tan liquors, consisting of about two-thirds quebracho to one-third hemlock. This tannage can be used for tanning almost all varieties of leather.

The color is fair and uniform; and the reduction of time consumed by the process is about one-third of that required where bark liquors and layaways are used. The leather is readily colored with little or no bleaching. Where hemlock bark is not obtainable, hemlock extract can be used in place of the bark liquor. The sides are first suspended in a weak coloring liquor for about twenty-four hours. They are then taken out and placed in a liquor of a strength of 10° barkometer. As the tanning progresses the liquor is strengthened each day until it is about 30° barkometer. The tanning should not be hurried by using strong liquor as this makes harsher and less desirable leather than a slower tannage in weak liquor. When the sides have become well struck through with the tan, which takes about twenty days, they are pressed and split. The grains are then retanned with hemlock and quebracho liquor, or with gambier and sumac. A small proportion of sulphonated oil may be added to the retanning liquor with benefit to the leather.

Tanning with Quebracho Extract.—Quebracho extract is at present used by tanners of sheepskins as well as by those of sole, upper and other heavy leathers. On skins, quebracho extract is an admirable substitute for the higher-priced gambier, producing fine grain, soft texture and firm feel. On patent leather it gives a pliability which prevents cracking after the

varnish is put on. On bag and strap leather it makes the light color that is necessary for dyeing with aniline colors. On harness and belting stock it produces the requisite tensile strength and toughness, and it enables the leather to carry all the grease needed. On sole leather it reduces the time necessary for giving good grains, and makes more mellow stock than a straight bark tannage. In fact, some sole-leather tanners are using quebracho to give them extra weight, for experience seems to have demonstrated that, owing to its peculiar concentration, it readily penetrates hides already well tanned.

The quebracho tree grows in the central part of the Argentine Republic, and it is one of the hardest woods known. It is most difficult to cut, and derives its name ("*Quebrar*"—to break—"*ache*"—an axe) from the fact that the best axes go to pieces in cutting down the trees. The tree is of extremely slow growth, and logs such as are shipped to the United States and Europe for the purpose of making extract are often from trees a thousand years old. The heaviest machinery is required for cutting this wood up into a form suitable for extraction, and owing to its great weight the handling of quebracho logs, which often weigh two or three tons each, is both difficult and dangerous. The bark of the tree is useless for tanning purposes, and, together with the sapwood, is removed before the logs are ready for shipment.

The extract made from the wood of the quebracho tree is different from all other known tanning extracts in that it will not turn sour. In addition to this it is a comparatively clean extract, that is to say, it contains a higher percentage of tan to a given density than any other of the well-known extracts. Inasmuch as it has little or no tendency to fermentation, quebracho is extremely useful for controlling the acids in tan yards that tend to go sour. On the other hand, if it is used in yards where considerable acid is needed, care must be taken to prevent the sweetening up of the liquors by the use of too much of it. This is obviated by the use of artificial acid or, as in Europe, by the employment of other tannins which contain a large proportion of other materials.

Quebracho extract, being a sweet tan, is not itself a plumper, and if it is used on leather which has not been properly plumped is apt to quickly tan the outside of the hides and thereby prevent the penetration of the tan to the inside, the result being cracky leather not properly filled. If, however, hides are plumped before they are placed in quebracho liquor, this material will penetrate, fill and produce tough, pliable stock of light color.

A very important point to be observed in using quebracho extract is that it must be dissolved properly. Solid extract needs to be boiled up in hot water in a tub containing a false screen bottom which prevents its adhering to a solid surface. The liquid extract should be dissolved in water at 180° F. The resulting solutions from both grades of extract should then be stirred well and allowed to cool down gradually before being used. It is a great mistake to run hot quebracho liquor into cold vat liquors, or in fact to suddenly chill any extract liquor. Such sediment as remains in the cooling tub may be worked up with fresh water on a tail leach or elsewhere. A great deal of the successful use of quebracho in the vats depends upon the proper manner of dissolving it, and it is much better that such precipitation as takes place should go on in the cooling tub rather than on the leather.

The barkometer underrates the strength of tannin in quebracho when compared to the strength of ordinary bark liquors. This is owing to the fact that the quebracho wood contains very much less material which forces up a barkometer than does bark. A pure quebracho liquor, for instance, made up from nothing but quebracho extract and water is, at 20° barkometer, fully as strong in tan as a sweet bark liquor of about 30° barkometer. This variation in the barkometer value must be taken into consideration, or else the tanner is apt to get the liquor too strong and burn the fiber of the leather.

Quebracho extract tends to make pliable rather than hard leather, the latter resulting more or less from sour liquors. On heavy leathers, such as harness and belting, it is extremely

useful on account of the toughness it gives to them. It is being used with success on upper leathers for a fore-tannage, and also for retanning splits coming therefrom. On patent leather it gives pliability and tough grain. The extract produces leather of an oak shade with a light pinkish tendency. Leather tanned with this material, however, should not be dried in the sun as the color becomes red on exposure to the light.

Hides intended for quebracho liquors should be thoroughly cleansed from lime since quebracho and lime do not go at all well together; thorough bating is therefore essential. Bad grain and poor color are the results of tanning hides containing lime in quebracho liquors. Quebracho is useful in the tanning of heavy leathers in strengthening the head liquors and in keeping them sweet. It penetrates very quickly, and by its use tanners are often enabled to increase the weight of their leather. The best results are obtained by mixing quebracho extract with other tanning materials, such as oak, chestnut and hemlock. The process of tanning is quickened by the use of quebracho, and the cost is somewhat cheapened. It is useful in making sole leather as well as upper and harness leathers.

Tanning is begun in weak liquor which is strengthened as the tanning proceeds until the sides are well struck through. The process can then be completed by drumming the leather in a fairly strong solution of the extract, then washing, pressing and fat-liquoring the stock and hanging it up to dry.

Tanning with Chestnut Extract.—Chestnut extract, prepared with care, is practically a pure solution of chestnut wood tannin, rich in tanning power per unit of density, and soluble to a high degree. It will form liquors free from sediment or liquor-filth, well-balanced in tannin and non-tannin for oak and hemlock yards, and fitted for the business of tanning hide fiber with celerity and thoroughness.

The successful use of chestnut extract, as well as that of any other process capable of various applications, is based upon general principles which may be briefly stated thus: Chestnut

extract is midway between oak and hemlock in souring qualities; hence it acts beneficially in both yards. The hemlock tanner, fighting for acid in his sour end, gets it by chestnut admixture; the oak tanner, combating excess sour in his handlers, controls conditions by chestnut in his head liquors.

Chestnut extract should for color reasons be well incorporated with the leach liquors. Its natural color is brown, which the extract manufacture modifies towards red by treatment. Mix as much as 75 per cent. with the leach liquors, and the bark color will dominate. Tan the stock in chestnut alone and the color will be "on the brown". This is the only secret regarding color in the use of chestnut extract. Put it on the head leach, through the sprinklers, or a little at a time as the leach fills with bark, and take down the liquors in the time-honored manner, making the draw of the desired barkometer average. As the yard becomes saturated with the chestnut, several things will be observed—the packs will feed more rapidly, they will "stand up" higher, and the plumpness put into the stock in the sours will hold up to the rolling room. This is because the liquors sent to the stock are richer in tannin per unit of barkometer, without an increase of the liquor-filth which impedes entrance of the tannin into the fiber of the stock. Leather is made in the beamhouse and the sour end of the yard; most anything can be done to it if proper beam-treatment and plumpness are parts of its record, so long as it is fed. After the handler period is past, the stock should enter the heavier liquors in the state of plumpness and grain wanted in the finished state, and from that point forward it should be struck steadily and persistently, with such frequent shifting as will keep the feeding process continuous.

The function of chestnut extract is thus made clear. It is a tanning agent pure and simple, with souring properties halfway between hemlock and oak, aiding the handlers in one and restraining them in the other. No other extract possesses this unique feature. The amount of combined tannin which can be put into a hide depends almost wholly upon the degree

in which the initial plumpness is retained during the passage of the stock through the true tanning liquors, those beyond the handlers. If these liquors are clean and grade up from 20° barkometer in the first layer to from 50° to 60° in the last, the combining process will proceed uniformly and steadily, flanks will be full and firm, the cut will show as much color from the one side as the other, and the " white streak " will be firm and plump. Such leather has good market qualities, and also has more room for finishing material and a larger area of hide-fiber to take the tannin. Chestnut extract promotes exactly these conditions, with, at the same time, a beneficial effect on the sour end of the yard.

There are various ways of using this extract. By some it is put directly on the leaches, and there allowed to dissolve and percolate through the ground bark. The chief advantage claimed for this is that the disagreeable bluish-gray color on the stock is avoided. Other tanners dissolve the extract in a separate tank and then run it on the leaches through the sprinklers. Some prefer to dissolve the extract separately, then mixing the solution with bark liquors as they come from the leach house. These methods, however, are not the latest nor the most approved ones, practical experiments having proved that chestnut extract is used most successfully along other lines, which may be described as follows:

The hides are soaked, fleshed, limed and unhaired in the usual way. After unhairing they are well worked on the grain, then left hanging over night in the old water pool, to which lactic acid has been added. For ordinary packs 40 lbs. will be sufficient. As they are plumped, and the fixed lime being also neutralized, the ordinary time in the handlers may safely be materially reduced. Coming from the cold water-pool, the hides should again be washed on the grain before going to the liquors. The green pack is given a week in the handlers, which are soured to the proper degree by the addition of lactic acid. The hides go from the handlers through the first two layers, after which they are run through a roller press, and are then ready for the drumming process.

The extract is poured into hot water, and the solution is run on the stock through the gudgeon at about 16° barkometer. At first the drum is revolved slowly. The two essentials at this stage of the process are the maintenance of the liquor strength and keeping the stock comparatively cool. When the hides become warm they should be withdrawn and allowed to cool. During this interval the old drum liquors are run to the handlers and new liquor is supplied to the drums.

After the leather is thoroughly tanned, weight is given by putting it in a drum together with a certain amount of undissolved extract and then drumming long enough to have it take up the extract. It is then finished as usual. One of the advantages of the drum system is that entirely sweet liquors can thus be given to the stock, since the natural resistance of the fiber to the penetrating power of the tannin is overcome by the agitation. However, it can readily be seen that the old drum liquors sent to the handlers will not contain a sufficient amount of free acids, other than tannin, requisite for the holding of the plumpness of the hides; hence it is necessary to add lactic acid to the handlers in order that the proper relations of the acids may be maintained. As there is an absence of natural lactic acid, the best results are obtained by adding the commercial article to the head handler liquor in the proportion of 1 lb. of lactic acid to every 100 lbs. of hides, green weight. Besides adding to the head handler liquor, it is advisable to add lactic acid to the other handlers halfway down the series, in amounts growing smaller from the head liquor.

Chestnut extract is a valuable tanning material for the tanner of heavy leather, its tannin being so easily available that it is one of the most acceptable on the market. Light skins, prepared as for any other tannage, may be tanned by suspension in chestnut liquor or drummed in liquor made direct from the extract, or from a mixture of two extracts. Skins intended to be colored subsequent to tanning are usually tanned direct in the extract liquor, with occasionally a retan in sumac. Stock to be run in the natural color is usually struck in the

mixture, giving the shade desired. With very thin leathers the main requirement of the tanning material is that it shall be clean, bright, and quick in action.

Light hides for side leathers are first put through a series of sour liquors, in which they are plumped. The liquors are prepared by direct solution of the extract in water or freshly-made bark liquor; thus prepared, they are given sweet to the nearly struck goods, usually as layaways, not infrequently in revolving drums. These stocks are always tanned out in relatively weak liquors, rarely exceeding 15° barkometer, as freshly prepared. Tanning is then completed in drums. Where a particular color quality is desired the leather is re-tanned with suitable material, such as gambier, mimosa, quebracho, sumac, etc., according to the shade or color condition sought.

Tanning with Gambier, Sumac and Oak Extract.—Where a soft, well-tanned leather is wanted that can be colored any shade or dyed black, a tannage with gambier, sumac and oak extract may be used with satisfactory results. The hides should preferably be split out of the lime and the grains then bated and washed. A liquor composed of gambier and sumac of about 10° barkometer is prepared in a paddle. After the grains have been in this liquor for five or six hours they are put into a gambier liquor of 20° barkometer, to which a quart of acetic acid for forty small grains has been added. Tanning may be accomplished by suspending the goods in the liquor, by using a paddle or by drumming after the grains have been well struck with the tan.

The third liquor should be made up to a strength of 35° barkometer and the same proportion of acid be added to it. After the grains have been in this liquor, a few pailfuls of oak wood extract should be dissolved and added. The tanning should continue until the goods are tanned throughout. When this has been accomplished the leather is drained and then treated with sumac in a drum or a paddle.

A sumac liquor is made up in a paddle by using 25 lbs. of best sumac in water heated to 125° F., the liquor being cooled

down to 90° F. before the skins are put in. The leather may be turned in this liquor several times and left in over night, or drummed with it two hours; it is then drained, rinsed off and dried or fat-liquored, dried, colored, dried again and finished.

Undoubtedly equally good results would be obtained by using quebracho extract in place of gambier. In the last stages of tanning, if a drum is used, some sulphonated oil may be added to the liquor. This helps in getting leather dried soft and pliable, and reduces the amount of fat-liquor to be given later on. The sumac for one dozen sides may be made of 2 pailfuls of sumac, scalded in 20 gallons of water and used at 90° F. The leather may be drummed in the liquor two hours, piled down twenty-four hours, drummed again two hours, rinsed off and dried.

Combination Tannage.—A process of tanning hides in a combination process is described in *Schuh and Leder* as follows:

The beamhouse work is conducted similarly to that for other upper leathers, and is generally hastened as much as possible with arsenic in the limes. After the sides have been bated and washed they are pickled with sulphuric acid and salt. A medium-sized paddle wheel is filled half full of water; 30 lbs. of sulphuric acid and 80 lbs. of salt are added and the whole is set in motion and thoroughly mixed. The quantities given are for 1000 lbs. of stock. The hides are run in this liquor three hours or drummed with it one hour, and are then allowed to drain several hours. Tanning is now commenced and is accomplished as follows: For 1000 lbs. of hides 60 lbs. of gambier, 60 lbs. of palmetto extract and 50 lbs. of quebracho extract are dissolved in sufficient water to make a rather thin liquor. In a separate vessel 25 lbs. of chrome alum and 40 lbs. of salt are dissolved, and the whole arranged to produce 40 pailfuls of liquor. Tanning is effected in the paddle wheel, and if a fresh liquor is used 5 lbs. of sulphuric acid must be added, then 5 pailfuls of the extract each morning and evening. On the fourth day the first part of the tannage is ended. Tanning may also be effected by hanging the

sides in the liquor. After the first part of the tannage is completed the leather is washed, pressed, split and shaved. For the retannage which now follows, 6 pailfuls of strong liquor are given for each 100 lbs. of split leather, and the latter is run in the wheel from two to three hours, then washed and pressed again, but this time only to a certain degree. If it is pressed too dry it will absorb too much grease, and if it is left too wet sufficient grease cannot enter. Various combinations of greases may be used. The original process called for 7 lbs. of moellon degras, 4 lbs. of tallow and 5 lbs. of paraffin oil for 100 lbs. of leather, the same being run with this mixture one hour. After the leather has been dried it is dampened and set out on both sides and blacked to suit. A more modern process consists of fat-liquoring the leather immediately after it is tanned, using an acid fat-liquor, and then drying it out and dyeing it later on.

Tanning with Gambier.—The sides are started in weak liquor which is gradually strengthened by the addition of fresh gambier until it becomes fairly strong towards the end of the process. Common salt serves a useful purpose in gambier tanning. It assists in making soft leather, in hastening the tannage, and prevents contraction of the leather fibers. Acetic acid also should be added to gambier liquor to prevent thin, papery leather. It is well for the tanner to divide his tanning liquors into three sections. In the first section the hides are colored; in the second section the tanning goes forward until the leather is ready for splitting; in the third or last section the retanning after splitting is accomplished. At the beginning the liquor may be 4° or 5° barkometer. It should be strengthened twice each day, the quantity of fresh liquor that is added depending upon the size of the vats and the strength of the liquor at the start. No exact rule can be laid down as the tanner must decide this and other questions by his judgment. The tanning should always go steadily forward until the hides are tanned throughout, when the leather should be split, retanned and fat-liquored.

Combination Process.—A tanning process in which hemlock,

chestnut wood and quebracho extracts are used for tanning and quebracho and gambier for retanning is carried out in the following manner: The hides are hung on sticks in a 7° barkometer hemlock liquor, and are handled every day for three days, the liquor being strengthened up to 10° and finally up to 12°. After having been in the 12° liquor twenty-four hours, the sides are passed into a 16° combination liquor, made of chestnut-wood extract and quebracho extract. This liquor is gradually raised to 20°, the process requiring fourteen to sixteen days. The sides are then pressed, split and retanned. The retanning liquor is made of quebracho extract and gambier, 3 parts of the former and 1 part of the latter; the strength 26° barkometer. The grains are drummed in this liquor one hour, then left in piles twenty-four hours; drummed again for one hour; piled down for twenty-four hours; then washed and finished. This is a good tannage for many varieties of leather, shoe upper, bag, case, etc. As described it is most suitable for large, heavy hides.

Pressing and Splitting.—Before leather is split it is pressed to rid it of the surplus liquor and to put it into good condition for splitting. Considerable moisture should, however, be left in it. When pressed too dry, the leather must be milled with weak liquor to prepare it for the strong retan liquor, and this milling pounds the grain and makes it loose and "pipey."

When there is considerable moisture in the grains they do not need to be milled in weak liquor but can be put at once into the retan liquor. The more moisture there is in the grains the better the results.

Notes on the Tanning of Heavy Leather.—Hides that are to be tanned in drums should be limed only long enough to unhair easily, and considerable sodium sulphide should be used with the lime. Bating the limed hides in a cold bath of lactic acid is recommended, since it neutralizes and dissolves the lime without affecting the weight or solidity of the leather. Hides that have been delimed in a cold bath of lactic acid and then thoroughly worked out, tan rapidly, have good color and finish into plump, well-filled leather.

In the modern rapid tanning processes sole leather is tanned in hangers and layaways, and then made plump and solid by being drummed in strong liquor made from quebracho or bark extract. As the drum revolves the extract is forced into the leather, which in a few hours absorbs the condensed tanning material. Before this is done, however, the leather, already fairly well-tanned, is run through the wringing machine and the surplus liquor is forced out.

Some tanners use whole hides and by having plenty of liquor in the drum, get nice, smooth grain on their leather. The grain should be well set before the drumming in extract is begun. The extract is mixed with sweet liquor heated to 80° F.; it is also used in liquid form as taken from the tank or barrel. The leather, when the drumming is completed, is removed from the drum and placed in warm water for a few hours, which plumps it; it is then oiled, dried, sammied and rolled once or twice. When the preliminary tanning is done right, the finished leather is well-tanned, plump, solid and having good weight. Quebracho extract in concentrated form is the material usually preferred for the drumming process. Apparently firm and solid leather is obtained by using glucose, which makes plump flanks, bellies and shoulders, but the plumpness and solidity thus acquired are not real, and the leather does not give satisfaction.

The only way to make durable sole leather is by using nothing but vegetable tanning extracts. Some tanners, after the drumming in extract is completed, hang the leather in strong liquor made from the extracts from the drum; then they bleach it with acid and soda; oil it and hang it up to dry in a well ventilated but darkened room; then they roll it for market. A mixture of mineral oil and cod oil in equal proportions is often used for oiling sole leather. Soluble or sulphonated oil is also drummed into the leather and adds to its pliability and strength. When the drum process of tanning is used, it is the practice of some tanners to send the old drum liquors to the handlers. These drum liquors are entirely sweet and do not contain enough free acid to properly

plump the hides while they are in the handlers; hence it is necessary to add lactic acid to the liquor in order that there may be the requisite proportion of acid to plump the hides. Not only is it advisable to add the acid to the head handler liquor, but also to the handlers halfway down the series, in amounts growing smaller from the head liquor. The green hides are given a week in the handlers; next they go through a roller press or a wringer and are then ready for the drumming process. During the latter process the two essentials are the maintaining of the strength of the liquor and keeping the leather comparatively cool. When the hides are found to be heating, they should be allowed to cool off before proceeding with the drumming, and the old liquor be run to the handlers and fresh liquor supplied to the hides.

By neutralizing the lime in the hides by hanging them over night in cold water containing lactic acid, which also plumps them before putting them into the handlers, the length of time they have to remain in the handlers can be considerably reduced. Tan liquors at the present time usually contain too little acid to neutralize the lime and keep the hides plump, and some process of deliming is necessary. Lactic and acetic acids are commonly used in tan liquors. Butyric acid also is used for deliming, and is an excellent plumping acid for the early tan liquors. Some tanners drench their hides with boric acid, which not only removes the lime but also gives the grain a smooth, silky feel and appearance.

Tanners know that some tanning extracts are more astringent than others. When several tanning materials are being employed, it is the best practice to use the less astingent materials during the first or earlier stages of tanning and to use rockers, so that the hides can be kept in motion and the penetration of the liquor thus facilitated. The earlier liquors fix the grain and give it good color, and they should be quite weak. When the grain is colored and set, the hides are in condition to receive stronger liquors. The strength of tanning liquors should be increased rather slowly to prevent thickening the grain and a wrinkled or drawn appearance.

When very strong liquor is used during the early stages of tanning the exterior of the hides may be so hardened that the penetration of the liquor into the interior becomes impossible. Smooth grain and fibers completely tanned are obtained only when the rate of increase of tannin strength is very small.

Formula for Producing Plump Leather. The plumpness of leather can be considerably increased by treating the sides in the following manner:

Soaking.—Dissolve 5 lbs. of borax in hot water and add the solution to 1000 gallons of water. Soak the hides from twenty-four to forty-eight hours, changing the water if they are very dirty. The hides should be as clean as it is possible to make them before they are put into the lime.

Liming.—The liming process depends somewhat upon the kind of leather that is being made. Starting the hides in new and strong limes and finishing up in weak ones makes the leather very plump as well as soft, but as extreme plumping at the start tends to weaken the fibers, it is better to start liming in weak limes and finish up in strong ones.

Bating.—Place the sides in a vat provided with a wheel and add to the water a solution of 3 lbs. of sulphuric acid, and 3 lbs. each of borax and Glauber's salt, dissolved and added to sufficient water to cover the hides. Five hours will be long enough to bate the hides, provided they are frequently stirred by the wheel. The same process in a tub or vat without a wheel takes thirty-six hours.

Tanning.—Suspend the hides in a liquor made up by putting 6 lbs. of borax (dissolved) into a vat containing about 1200 gallons of weak hemlock liquor. Keep them in until the color is struck; then plump the liquor into a leach of bark, and steel it for the second run; add no more borax until after the third run, then add $2\frac{1}{2}$ lbs. of it (dissolved) to the liquor that is to be pumped into the leach for the fourth run. Then finish up the tanning with quermos or quebracho extract liquors. In depending too much upon quebracho as a tanning agent without anything else, plumping and filling qualities are lost, which are gained by using hemlock bark

or extract liquor as a striker. The borax should be used exactly as directed to get satisfactory results.

Retanning with Gambier and Sumac.

Leather that has been tanned in hemlock liquors, no matter what the finish may be, is much improved by being retanned with gambier and sumac. Retanned in this way, the flanks are made fuller and firmer, the fibers are slightly contracted, the harsh effect of the hemlock is toned down, the leather is given a smooth feel, and the color is less liable to fade. The leather is tanned with hemlock and then split.

The retanning is effected in a drum, it being thus accomplished in less time than in a vat. A good retanning liquor for harness and other kinds of leather is prepared in the following manner: Boil in 80 gallons of water 250 lbs. of gambier; when the solution is fairly cool skim off all foreign matter. Ten gallons of this liquor are sufficient for thirty average sides. This quantity is put into the drum together with the leather, and to it are added 2 gallons of dry sumac and as much water as is needed to make the leather wet without dripping. Run the leather in this liquor at least thirty minutes. The sides should then be packed in boxes by doubling the flesh side outwards, and left in that condition for ten or twelve hours.

They should next be scoured or washed and treated in the usual way of coloring, fat-liquoring, etc., according to the kind of leather and the finish that is wanted. Gambier and sumac used as described improve the leather greatly, and the expense of their use is repaid by the improved quality. Bark-tanned and extract-tanned leather may be retanned with gambier and sumac in the following manner: Two pailfuls of Sicily sumac are boiled fifteen minutes in 40 gallons of water, and the resulting liquor is allowed to stand over night. The next morning 12½ lbs. of gambier are boiled until dissolved, and this solution together with 10 lbs. of salt is added to the sumac liquor. There should be 50 gallons of the liquor, and it should be used at 80° F. The leather is run in it one hour, then left in piles twenty-four hours, next rinsed off and fat-

liquored. Before being retanned, the leather, after it has been split and shaved, should be washed one-half hour in warm water containing 3 lbs. of salts of tartar in 50 gallons of water. It is next drained and washed and then retanned.

Retanning Grains with Sumac.—Hemlock-tanned and combination-tanned leather after it has been split into grains and splits is benefited by a retannage with sumac. The sides are taken out of the last tan liquor and allowed to lie in a pile forty-eight hours. They are then pressed or put through a wringer to force out the surplus liquor. Some tanners run their leather through a splitting machine with a corrugated gauge roll, which makes pressing unnecessary. Leather that has been pressed usually shows some marks, and to remove these it is jacked on a stoning jack.

Splitting is next done to the substance that is wanted, and the grains are then retanned with sumac in a drum. This retanning is very beneficial to the leather, making it of finer texture and color, and also rendering it capable of taking better and more uniform coloring.

The sumac liquor is prepared by scalding 2 pailfuls of sumac with 20 gallons of water heated to 125° F., and allowing it to steep some time before using it. When the liquor is cool it is ready for use, this quantity being sufficient for one dozen medium sides. The leather is drummed in this liquor one hour. It is then placed in smooth piles for twenty-four hours, when it is drummed again with sumac liquor the same as before, then again piled down for twenty-four hours. The next operation is dipping it in warm water to wash off the sumac and then scouring or setting it out and finishing it according to the finish that is wanted. It can be dried and then fat-liquored later on.

The splits for flexibles or Goodyears are trimmed and put into a drum together with tan liquor of 6° barkometer strength and drummed one hour, which opens them so they will take the retanning liquor. Retanning can be done in a drum in about six days, the splits being drummed in a strong liquor two hours each day and left in piles the rest of the time.

This operation is repeated daily for six days, when the splits will be fully tanned and in better condition than when they are drummed continuously.

Gambier, hemlock extract and alum make a good retannage for hemlock-tanned leather. The proportions of gambier and hemlock should be equal parts of each, the strength being 25° barkometer. Twenty-five sides should be given 4 pailfuls of the liquor and 4 lbs. of alum dissolved in 2 gallons of water. The leather is run with this liquor one hour, then piled down over night and hung up the next morning to dry. When dry, it is fat-liquored, colored and finished.

A combination of 75 per cent. of quebracho and 25 per cent. gambier is recommended for retanning grains for upper leather. One pint of bisulphite of soda added to each 3 gallons of retanning liquor causes the liquor to penetrate more quickly into the leather. The strength of the quebracho-gambier liquor should be from 24° to 28°.

Any of the foregoing processes may be used in the retanning of leather for colored and black upper stock, dull or bright printed grains and imitation kangaroo, also for bag and case leathers.

Coloring and Finishing Vegetable-Tanned Upper Leather.

Hides that have been tanned by a gambier, quebracho, or combination process can be finished in various ways. For black upper leather, glazed or dull, the following process may be carried out: The grains of sides split out of lime, bated, pickled and tanned, or the grains of sides split after tanning and then retanned, are washed and pressed. They are then fat-liquored with a suitable fat-liquor and dried. The dry leather is then wet down and colored blue or blue-black throughout the flesh and as a foundation for the subsequent black. The grain is next dyed black with logwood and striker, or with a direct leather black applied by brushing on. The skin is then slicked out smooth and hung up to dry; next dampened, staked and trimmed. If a dull finish is wanted a

coat of dull dressing is applied and the leather is ironed or rolled. Where a smooth bright finish is desired a suitable seasoning is applied to the grain and when it is dry, the leather is glazed and then staked; it is then given another coat of seasoning, dried and glazed again and next staked in the same manner as before. A third coat of seasoning is then applied and the leather is again dried and glazed. Thus colored and finished, the leather has a blue or black flesh, a jet black grain and a brilliant finish that resembles glazed kid; it is also very soft and durable.

Where colored leather is wanted, the leather is fat-liquored and dried; then treated with sumac and colored; or it may be fat-liquored after coloring and then dried and finished.

For both black and colored leather the writer would recommend the use of sulphonated oil fat-liquor; and for black leather, flesh coloring with acid dyestuffs and grain blacking with a direct black applied by brushing on after the leather has been flesh colored and dried.

Formulas for Black Flesh and Grain.—1. Where the black is desired throughout the leather, the result can be accomplished by using logwood and titanium-potassium oxalate. Drum the leather, dried after tanning, in a solution of 5 or 6 ozs. of titanium-salt for 100 lbs. of dry leather for ten minutes; next pour alkaline logwood liquor into the drum and let the leather drum fifteen minutes; then pour in another solution of titanium-salt and drum ten minutes longer. Wash the leather and if it was not fat-liquored before it was dried, fat-liquor it with suitable fat-liquor and then dry it for finishing; if it was not fat-liquored before it was dried, apply the fat-liquor immediately after dyeing in the drum.

2. Where it is desired to dye only the grain black, leaving the flesh undyed, the use of direct blacks such as Leather Black TB and TG patd. (Cassella) is to be preferred. For bright finish the bluish Leather Black TB is especially well suited; for leather that is to be finished dull the deeper and somewhat more greenish Leather Black TG is to be given the preference. Leather which is given a moderate polish by being rolled or

brushed may be dyed equally well with either brand. No preparatory or after treatment is necessary.

Blacking the grain side only is done by brushing the solution of dye into the grain, two coats being generally sufficient for the dry leather. The color solution consists of 1 lb. of the leather black and 8 ozs. of acetic acid in 10 gallons of water, the temperature being maintained at 120° to 140° F. during the operation. The dye is mixed with the acid and some water to a pulp, and then enough boiling water is with constant stirring, poured over the pulp to make a solution of the proper strength.

3. *Blue Flesh and Black Grain.*—If the flesh side of the leather is to be dyed blue, an acid blue such as Solid Blue R, Naphthol Blue or Naphthol Blue Black is used, the coloring being accomplished by drumming the leather with the color solution for one-half hour at 115° F., 6 or 8 ozs. of the color and 3 or 4 ozs. of sulphuric acid, or 6 or 8 ozs. of acetic acid being used for 100 lbs. of leather. The leather is then set out strongly and, after having been dried, is blacked on the grain by brushing on a solution of 1 lb. of leather Black TB or TG, and 8 ozs. of acetic acid in 10 gallons. of water.

4. *Black Flesh and Black Grain.*—Where it is considered desirable to dye both the flesh side and the grain side of the leather black, the result may be accomplished by drumming the leather with a solution of the leather black, using 1½ lbs. of the color for 100 lbs. of leather and adding from 3 to 5 ozs. of acetic acid to the necessary volume of water. The leather is then washed and dried, or if not previously fat-liquored, is fat-liquored directly after it is dyed and then dried and finished.

Yellow Flesh and Black Grain.—1. After leather that is to be finished into imitation kangaroo has been fat-liquored and dried, the flesh can be colored yellow by using 5 lbs. of turmeric, 1 lb. of sal soda, 1 lb. of borax, 1 gallon of neatsfoot oil, boiled in 10 gallons of water. Then fill the barrel with cold water and use 12 pailfuls of the liquor for a drumful of leather. After the flesh has been covered, black the grain with logwood and striker, or a direct leather black.

2. Yellow flesh can also be obtained by using yellow aniline dye. The leather is dampened and placed in piles to soften. One-half pailful of sumac is scalded for two hours in a covered vessel. To the prepared sumac 4 pailfuls of water and 1 gallon of lactracine are added, this quantity of liquor sufficing for 60 medium sides. It is used at 100° F., and the leather is drummed in it twenty minutes, when it is ready for the yellow dye. Yellow S is a suitable dye to use, 1 lb. of it being dissolved in 25 gallons of water and applied to the leather in a drum at 100° F. The leather is then blacked on the grain, oiled and dried; 4 pailfuls of the yellow dye will color 100 lbs. of dry leather.

Fat-liquoring and Finishing Side Leathers.

In the finishing of sides into dull and glazed boarded grain leather, imitation kangaroo and black and colored Russia leather, a not uncommon practice is to give the goods two applications of fat-liquor, one before and one after coloring. Both fat-liquors may be sulphonated oil, or the first may be a solution of the oil, and the second an emulsion of oil, soap and degras. The procedure is as follows: After the leather has been split, retanned, pressed and shaved, it is sammied and then weighed for the first application of fat-liquor. The drum is heated with live steam to 125° F., and the leather put in together with a small quantity of hot water and drummed until it is fulled and the moisture evenly distributed, the fat-liquor being thus rapidly absorbed. Another way to moisten the leather is to dip it into warm water and place it in piles until it is softened throughout, this being less apt to pipe the grain than dampening in the drum. An excess of water in the drum or in the leather must be guarded against as it prevents the absorption of the fat-liquor, which should be used at 125° F. It should be poured into the drum through the hollow axle while the drum is in motion. A drumming for thirty minutes enables the leather to absorb all the fatty matter from the liquor. After having received the first application of fat-liquor, the leather is rinsed off in clean water to free it

from particles of leather fiber and fleshings, which, containing oil, are liable to spot the leather while it is drying. Previous to being hung up to dry, the leather should be placed on a horse for a few hours, to allow the fatty matter to assimilate with the tannin and to penetrate into the leather, which is then hung up and dried.

When leather is given two applications of fat-liquor, the first application should be at least half of the whole quantity used. Colored leather can be given no better fat-liquor than sulphonated oil, used by itself or combined with neatsfoot oil or degras, such fat-liquor being also good for black leather. A thoroughly emulsified fat-liquor of soap, oil and degras is also quite suitable, while some tanners prefer to buy a commercial fat-liquor to making it themselves.

Glazed and boarded grain leather is colored blue on the flesh side before the second application of fat-liquor and blacked upon the grain afterwards; flesh and grain may also be dyed at one operation.

Colored Russia leather is usually bleached, mordanted and and colored previous to the second application of fat-liquor.

When dry from the first application of fat-liquor the leather is dampened and colored, then dried and dampened again for the second fat-liquoring. Imitation kangaroo and dull grains are usually yellow-backed before the second application of fat-liquor. After it is fat-liquored, the leather is again dried for finishing. Kangaroo calf and sides are sometimes fat-liquored and dried, then yellow-backed, grain-blacked, dried and finished. The leather may be washed after retanning, pressed and fat-liquored, dried and then colored and finished.

Quebracho-tanned, gambier-tanned and combination-tanned leather can be handled in the following manner with satisfactory results: When the retanning is completed the sides are washed and pressed to remove surplus liquor. Some tanners merely press their leather and do not wash it. After pressing, the leather is shaved and fat-liquored. In some cases it is drummed with oil and dried before it is fat-liquored, this being a good method to follow in finishing colored leather. A drum

is heated with steam to 100° F., and 1 gallon of oil is used for 150 lbs. of leather, weighed after pressing and shaving. The leather is drummed with the oil one-half hour, then hung up and dried. Sulphonated oil is recommended for this purpose, although any other good oil may be used. After drying, the leather is weighed and dampened with warm water and placed in piles to soften. It is then put into the drum and run with just enough water to soften it uniformly, and is now in condition to receive the fat-liquor. This method is entirely practicable and satisfactory; but some tanners omit the oil and fat-liquor the leather after it has been drained and pressed.

To fat-liquor the leather, the drum should be heated with live steam to 125° F., and the leather be drummed in warm water until it is soft and full. The fat-liquor should be given to the leather in portions of 1 to 2 gallons at a time through the hollow gudgeon, and after all of it is in the drum, the leather should be drummed forty minutes. Upon being taken out of the drum the leather should be rinsed in clean warm water, drained and dried. When dry, it may be colored blue on the flesh and black on the grain, or yellow upon the flesh and black on the grain, or it may be colored any shade with aniline dye, dried and finished with smooth, boarded or printed grain, or into imitation kangaroo leather.

The following fat-liquors have been used in tannery practice with good results:

Fat-liquor Formulas.—1. Boil 25 lbs. of potash soap in 25 gallons of water until it is dissolved. Add to the solution 50 lbs. of English sod oil and 6 quarts of neatsfoot oil and stir several minutes. A few pounds of moellen degras may also be added. Enough cold water is next introduced to make 50 gallons of liquor. Twenty gallons of this fat-liquor suffices for 100 lbs. of dry leather that has been run in oil previous to being dried. The exact quantity to use, however, varies with the tannages, some requiring more than others, the quantity stated being the maximum, and a smaller quantity will in most cases produce the desired result. This is a good fat-liquor for black and colored combination-tanned leather.

2. 5 lbs. of soap and 1 gallon of moellon degras boiled and made into a fat-liquor with one-half barrelful of water, this quantity being sufficient for 400 lbs. of leather. It may be applied to the leather immediately after tanning is completed, or the leather may be drummed with a little oil and dried before it is fat-liquored.

3. A good stuffing for imitation kangaroo and dull printed sides is made of 12 lbs. of cod oil to each 100 lbs. of leather, dried after retanning and weighed after it is dampened. Use at 130° F. Pack the leather down over night to harden; then set it out by hand and hang it up to dry. When dry, buff off the grain, trim and stake the leather; then color the flesh yellow and black the grain and finish the leather.

4. For hemlock-tanned, quebracho-tanned, gambier-tanned and combination-tanned leather the following fat-liquor is recommended: 10 lbs. of soap, 4 gallons of neatsfoot oil, 10 lbs. of degras to a barrelful of liquor. Use at 125° F., preferably after coloring; then set the leather out, oil the grain and hang up to dry. The leather, dried after retanning, is dampened and colored and then fat-liquored, when the grain is struck out and oiled with neatsfoot oil and the sides are then tacked on frames to dry. Ten gallons of this fat-liquor are sufficient for twenty-five sides of twenty-foot four-ounce leather. It is best to use the liquor after the leather has been dyed black, or colored.

5. For bright printed or boarded grains another suitable fat-liquor is: 12 lbs. of pure cod oil, 2 lbs. of French degras, 2 gallons of thin soft soap for 100 lbs. of damp leather. Apply at 125° F. The leather, after being retanned, should be drummed for one hour in warm, strong sumac liquor; then rinsed, scoured on both sides and hung up to dry. When dry, it is dampened and fat-liquored, and is then set out and a light coat of oil applied to the solid parts of the flesh side. The leather should be set out very tightly on both sides, since the tighter it is set, the finer and more even the grain will be when the leather is finished. When dry, the leather is dyed black, dried, staked and finished.

A Method of Finishing Vegetable-tanned Grains into Black Leather.—The goods after being fully retanned are washed, struck out, shaved and retanned with sumac at 90° F. The leather is put first into a sumac liquor that has been used for a previous pack, and after twenty-four hours is placed into a new bath. It is then horsed up, set out, oiled on the grain with cod oil or other leather oil, hung in the air, struck out on the flesh and fat-liquored on the flesh with a mixture of degras and cod oil, applied sparingly in order to avoid greasy grain. In place of this fat-liquor, the following may be used: For 100 lbs. of leather, 5 pints of cod oil, 5 pints of moellon degras, 5 lbs. of soap, 5 ozs. of borax and 15 gallons of water. After fat-liquoring, the grains are struck out on the flesh and grain and dried; stored a week or two and then dyed black. If the grain only is to be blacked it is brushed with a direct leather black. The grain is then oiled, and the leather is partially dried, boarded in several directions, laid in a pile over night, cleaned on the grain with a little barberry juice, dried and rubbed with a soft flannel rag. To obtain a bright finish a glaze seasoning is applied and when dry the grain is glazed, boarded again, given another coat of finish, dried, glazed and finally boarded again. Where smooth grain is wanted, boarding is of course, omitted. The flesh side can be stained by the addition of a suitable dye to the fat-liquor, and the grain be blacked afterwards.

Finish for Bright Boarded Grain Leather.—Dissolve in 3 gallons of soft water, 4 ozs. each of logwood extract and 4 ozs. of gelatine. When cold, add 2 ozs. of ammonia, 1 gallon of beef blood, 1 pint of milk, 2 ozs. of muriate of iron, and 2 ozs. of spirits of camphor. Mix 1 oz. of gelatine in milk before putting into the finish; then mix together, putting in the iron and camphor after the other ingredients have been worked together. Stir the mixture very thoroughly.

The dry leather should be dampened, staked and tacked; the grain then be dampened with warm, weak logwood liquor before it is finished. As soon as the grain is dry, apply the first coat of seasoning; dry the grain and then polish with

the jack. After polishing, dampen the leather and let it lay awhile to allow the dampness to penetrate evenly; then grain from tail to foreshank and from hindshank to top of shoulder, and soft-board crosswise on the flesh side. Let the leather dry, and then finish graining by boarding on grain side crosswise and lengthwise. Next apply two very light coats of seasoning, the first being allowed to dry before the second is applied. When the last coat is dry, the leather is ready for the last polishing. Sufficient pressure should be used to cause the grain to disappear and to bring the brightness from the bottom of the impression of the print. After the polishing the leather is staked and then given the last graining. Grain four ways on the grain side, very lightly, and the result will be a fine, even grain, very black and glossy. The finishing touch is a light coat of hot oil, made of equal parts of raw linseed, paraffin and sweet oils. After being oiled, allow the leather to lay in a pile for a few days before it is assorted and rolled into bundles. Dull boarded leather is made in the same manner, except that dull dressing is used. Printed grains are made by printing and graining the leather with the grain figure that is wanted.

Finishing Kangaroo Side Leather.—Sides that have been tanned for kangaroo side leather are dried and fat-liquored with degras, stearine and fish oil, and after being dried the grain is buffed. The flesh is then dyed yellow and the grain is blacked with logwood and copperas or other striker, or with a direct black, given a coat of paste made of 2 quarts of flour, 10 quarts of water, 8 ozs. of tallow, 4 ozs. of beeswax and 2 quarts of linseed oil. Boil these ingredients one-half hour; then add 8 ozs. of soap, 3 ozs. of nigrosine black and boil fifteen minutes. Thin down with water and apply a fair coat to the leather; when dry, roll.

A suitable finish is made of: Casein, 1½ lbs.; olive-green soap, 1¼ lbs.; tallow, ½ lb.; German degras, ½ lb.; fish glue, 1½ lbs.; nigrosine black, ½ lb. Boil one hour, cool and add 1 pint of ammonia, and strain. This will make 6 gallons. Now make up in another tub the following: Irish moss 1¾

lbs.; olive-green soap, 1¼ lbs.; borax, ½ lb.; flour, 2 lbs.; nigrosine, ½ lb. Boil an hour and a half, cool and strain. This will make 6 gallons. Mix one-half the first and one-half of the second finish, and use it on the machine. It gives a medium bright finish. If the finished leather is too bright, use more of the moss finish. If a bright finish is wanted, omit the moss finish. Give the leather two coats of finish and roll it. If boarded kangaroo is wanted, the sides are to be boarded before any paste or finish is applied.

Some tanners prefer to give their kangaroo sides a light stuffing, next to dry them, dampen and color the flesh yellow, then to give another application of fat-liquor, and to color the grain black after this second fat-liquoring. Others color their leather yellow on the flesh and black on the grain before the second application of fat-liquor.

A sig to be used on greasy kangaroo sides to cut the grease out of the grain so that the dye can penetrate is made of 12 ozs. each of caustic soda and of salts of tartar boiled in 10 gallons of water, the barrel being then filled with water.

A logwood liquor is made by boiling 75 lbs. of chip logwood for two hours in 80 gallons of water, which will make one barrelful of liquor. Before using, add 2 pints of ammonia, and use at 105° F.

A black or striker is made of 8 lbs. of copperas, 2½ lbs. of bluestone, 1 lb. of nutgalls, 4 gallons of logwood liquor boiled in 15 gallons of water. Fill the barrel with cold water and add 8 ozs. of tincture or muriate of iron.

Coloring Vegetable-tanned Side Leather.

There are various methods of coloring the grains of side leather that has been tanned with gambier, quebracho extract, hemlock extract or a combination of extracts. It is always advisable to retan the leather with sumac before coloring, such retannage freshening up the leather and preparing it to receive the color. The treatment with sumac is best carried out in a drum; and after the leather has been thus retanned a solution of titanium-potassium oxalate is run into the drum

and the leather drummed a few minutes longer and then colored. This process of dyeing, combined with acid fat-liquoring, produces well-colored and well-nourished leather. To color 100 lbs. of dry leather use 8 ozs. of the titanium salt after the leather has been run in the sumac bath. Drum ten minutes. Then run the liquor out of the drum and run in the solution of aniline dye. After the color is well taken up, wash, and fat-liquor the leather if it had not been previously fat-liquored, or give it the second application of fat-liquor, according to the previous treatment. One course is to wash, press and fat-liquor the leather lightly with sulphonated oil; to dry it; then to dampen, sumac and color it; to give it the second fat-liquor, dry and finish it.

Another procedure consists of giving but one application of fat-liquor either immediately after tanning or after the leather has been colored.

Upon leather that has been fat-liquored with sulphonated oil and dried the following method of coloring shades of tan and brown will be found to be satisfactory: For 100 lbs. of leather, washed and sumacked, start coloring with 1 to 3 lbs. of phosphine and 1 to 8 ozs. of shading brown, according to the shade required. Drum the leather in the color bath one-half hour. Then add without stopping the drum, 6 or 8 ozs. of titanium salt dissolved in hot water. Drum ten minutes, and then rinse the leather, set out well and tack in frames to dry for the final finishing.

Coloring Quebracho-tanned Grains.—When the grains of sides split out of lime and then bated, pickled and tanned are fully tanned, they may be washed and fat-liquored. For the fat-liquor Turkey red oil or acid fat-liquor may be used, 2 per cent. of the same being used at a temperature of 110° F. for thirty minutes, the leather being then washed again, set out and hung up to dry. A fat-liquor of oil and soap may be used, but there are advantages in the use of sulphonated oil.

When the grains are dry it is beneficial to their texture to keep them in the dry or crust state a week or two before they are sorted for coloring. For light-colored leather it is best to

select those grains that have no imperfections and are of a light, clear color. Leather that has a dark grain should be cleared with sulphuric acid, 1 pint of it being used for forty or fifty sides in warm water in a paddle vat or a drum.

The next process is treatment with sumac, 3 lbs. of it, well scalded and mashed, being used for 50 grains. After being paddled in the sumac bath an hour or drummed in it twenty minutes, the leather is set out and colored. The sulphuric acid should be entirely washed out of the leather before the sumac is applied.

One method of coloring is carried out in the following manner: The leather is drummed in the warm sumac liquor one-half hour. One-half per cent. of tartar emetic dissolved in hot water is next poured into the drum and the drumming is continued twenty minutes longer. The liquor is then drained out of the drum, and the leather is washed. Coloring is done very satisfactorily with acid dyes and formic acid. The solution of the dyestuff is prepared by boiling in the usual manner and is made acid by the addition of 4 or 5 ozs. of formic acid for 100 lbs. of leather.

Some dyers, however, prefer to first run the leather in the dye liquor and then a few minutes later to add the acid diluted with water. Water warmed to 120° F. is put into the drum together with the leather, and after a few minutes' drumming one-third of the dye liquor is poured in, and the drumming continued a few minutes; then another portion of dye is poured into the drum, and after a few minutes the remainder of the liquor is poured in and the drum allowed to run twenty minutes. Where the dye liquor is not acidulated before coloring is begun, the acid is added after the leather and the color have been drumming ten or fifteen minutes. Finally the leather is washed, and where fat-liquoring is not done, after tanning, it is done after coloring, and the leather is set out, oiled lightly on the grain and hung up to dry or tacked in frames or on boards and dried. It is then staked and finished.

The first coat of seasoning may be a cold solution of flax-

seed, applied with a sponge, and while the grain is still damp the leather is rolled, brushed and staked lightly. A bright seasoning is next applied, and when dry the leather is rolled or glazed. Skins for black leather are taken in the dry conditions aud brushed on the grain with a solution of direct leather black, which leaves the flesh uncolored. Where the flesh also is wanted colored; the leather is drummed with a solution of blue acid dye, then dried and blacked upon the grain. When dry it is seasoned, rolled or glazed or grained as may be desired.

Another method of coloring consists of mordanting the leather after it has been cleared with acid and drummed in sumac, with a solution of fustic extract and titanium salt, then coloring to the shade that is wanted. When a printed or embossed grain is wanted, the tannage should be rather firm and dry, and very little fat-liquor be used. Finished upon the flesh side, quebracho-tanned leather makes fine ooze or velvet stock.

Vegetable-tanned Patent Shoe Tipping.

The tanner who makes chrome leather from hides can realize greater profit from his poor-grained hides by working them into tipping stock than by allowing them to go through the works and then be sold as No. 3 chrome or as a job lot of culls.

Good, strong tipping requires more liming than chrome leather. If the tanner will sort his hides after they are unhaired, he can have an extra lime pit and make up a medium strong lime liquor, and all hides with damaged grain can be put into this lime for from 24 to 48 hours, then put through the regular system of washing, working out, bating, etc. After having been bated down well (tipping stock should be bated low, so as to make soft, strong leather), the hides should be started to tan by tacking them on sticks and suspending them in a weak sour liquor. If a non-acid tanning agent is being used, the liquor should be turned to the acid side by the use of lactic acid. The first liquor should stand about 7° test with

a barkometer. Allow the hides to remain in this sour liquor 48 hours, then handle them over into another pit, or else draw off the sour liquor and pump on a fresh sweet liquor of 10° strength. If handled over into the next pit, the hides should be pulled out and laid in a pile to drain for two hours in order that they will not carry too much of the sour liquor into the next pit. Allow them to remain in the 10° liquor forty-eight hours, then work them into a 12° liquor for forty-eight hours. Next work them into a 16° liquor and allow them to remain four days, but they must be handled each day and their positions changed, so that they will not have raw or kissed spots on them. After having been in the 16° liquor the requisite length of time, the hides are worked out into a 20° liquor and allowed to stay therein six days, when they are pulled down from the sticks and allowed to lay in a pile forty-eight hours. They are then pressed or put through a wringer so that they will be in condition for splitting, or they can be run through a splitting machine with a corrugated roll without pressing or wringing. If pressed or put through a wringer they must be jacked on a stoning jack to remove all marks.

After having been jacked they are split at a 2½ oz. gauge and the grains are then retanned in a mill with sumac, using two pailfuls of sumac to each dozen sides. Boil the sumac in about 20 gallons of water and allow it to stand until cool, then put in the leather and run an hour and a half; take the leather out and put it into a pile for twenty-four hours; then give it another run in sumac liquor made in the same way. The leather is piled down again and allowed to lay twenty-four hours. It is then dipped into a tubful of warm water to wash off the sumac and after that is scoured on the table. While on the table, give the leather a good coat of moellon degras, made by dissolving 4 ozs. of salts of tartar in 3 gallons of hot water and then stirring into the water 2 gallons of moellon degras. The leather is given a light coat of this slush, well rubbed in with a brush. It is now folded together and laid in a pile for 24 hours, then tacked out on frames. When dry it is buffed by hand, and either staked or soft-boarded and

pin-blocked to soften, when it is ready to japan. When a first-class moellon degras is used, degreasing is unnecessary.

Another Retanning Process.—A good way to fit bark-tanned leather for patent shoe tipping is to split and shave it on the machine, then for 50 medium sides dissolve 3 lbs. of salt of tartar (carbonate of potash) in 50 gallons of warm water and run in a mill for one-half hour, then drain and wash for fifteen minutes, when the leather will be in good condition to be retanned.

The retanning liquor is made as follows: Boil 2 pailfuls of sumac in 40 gallons of water ten minutes and allow to stand over night. In the morning dissolve 13 lbs. of gambier and 10 lbs. of salt and add the solution to the sumac liquor. There should be 50 gallons of liquor. Run the sides in this liquor one hour, using it at 80° F.; next pile them down on the floor for twelve to twenty-four hours, and then wash off the sumac in a tub of water.

The fat-liquor is made of soap, cod oil and moellon degras. Boil 1 lb. of fig soap until it is dissolved; add 4½ lbs. of cod oil and boil one-half hour; turn off steam and stir in 4½ lbs. of moellon degras of the best grade, and mix thoroughly. Now add 4 ozs. of salts of tartar dissolved, and fill the barrel with water to make 50 gallons of fat-liquor. Use at 110° F. Run the leather in the fat-liquor one-half hour, then set it out and tack it on frames; when it is dry, buff the grain and stake. This process makes fine, strong tipping that can be easily japanned.

The Manufacture of Goodyear Welting.

The better grades of welting are made from plump hides weighing fifty to sixty pounds each and tanned expressly for welting. Welting is also made from the shoulders of belting butts but such leather is apt to be harsh and brittle and not as satisfactory as that made from upper leather. The hides are limed thoroughly and bated down low to give a fine grain. The tanning should be effected somewhat slowly and the tannage be mild to prevent drawn and rough grain from too strong liquor.

Any good upper-leather tannage is suitable for welting. A combination of quebracho and hemlock extracts produces good leather. The proportions may be 1 part hemlock and 2 parts quebracho. The sides are suspended in weak coloring liquor for twenty-four hours and then transferred to stronger liquor, which is strengthened up from day to day until the sides are well struck through. Oak tan and oak and hemlock also made good welting leather. Leather tanned in weak liquors finishes softer and tougher than that rushed through strong liquor. The hides, when well struck with the tan, are put in the press and made ready to be split. Before being split, they are however cropped and the bellies sent back to be retanned. The backs are split 6 to 8 ozs., according to the weight desired, and are then put into a drum and retanned with strong gambier liquor. Sumac should not be used as it has a tendency to make the grain coarse. The next process is bleaching to remove the stains from the splitting machine. The leather is run in the drum for thirty minutes in a solution of 6 lbs. of borax in 40 gallons of water at 100° F. After this the leather is washed in clear water to remove the borax; it is then milled in a solution of sulphuric acid, using 1 pint of acid or more in 40 gallons of water and running the leather in it twenty minutes. The leather is then washed in clear water and fat-liquored.

Any good fat-liquor will do, but better results seem to be secured with the use of neatsfoot oil and chip soap. The leather is fat-liquored, dried and sammied and set out very thoroughly. A light coat of cod oil cut with 25 per cent. of paraffine oil is then given to the grain; the leather is next turned over and struck out on the flesh, a light coat of fat-liquor being then applied to the flesh and the leather hung up to dry. When partly dried, it is taken down and reset with a heavy slicker, then dried and put into press. It is not rolled nor is any finish applied. If the work is carefully done, the grain has a light, clear color that readily absorbs any strain or color that may be applied.

Rough leather of soft tannage makes good welting when

finished in this manner, but it must be firm and pliable and not harsh and brittle as much welting is.

The shoulders of the hides, the butts of which are made into belting, cut from the hides before they are tanned, are largely used as welting. The shoulders after having been tanned, are run through the splitting machine and leveled. They are then bleached with sulphuric acid after a borax bath as described, washed with clear water, scoured, hung up to dry, and when in condition to be rolled are rolled on the sole-leather roller. A coat of oil is next given to them and they are then dried out, receiving no other finish of any kind. This shoulder welting is never as good as that made from the backs of upper stock treated in the manner previously described. An oak tannage is preferred to other tannages for shoulder welting.

The Manufacture of Bag and Case Leathers.

The first essential in the manufacture of bag and case leathers is good hides, preferably green-salted, that are clear on the grain and free from butcher cuts on the flesh side. When the hides have been selected, trim off the heads and shanks and put the hides into clean soft water. The better way to soak them is to suspend them in the water and allow them to soak twenty-four hours; then take them out or run off the water and fill the vat with fresh water and soak them twenty-four hours longer. Then split them into sides, taking care to keep the backs straight. Five pounds of borax dissolved and added to 1000 gallons of water helps to soften and cleanse the hides. After having been split into sides, the hides are fleshed, when they are put into clean cold water over night and the next day into the lime.

Liming.—Liming usually requires six or or seven days, 8 lbs. of lime and 2 lbs. of sulphide of sodium for 100 lbs. of hides being usually sufficient. The first lime sould contain 1½ lbs. of lime. Reel the sides into the liquor, taking pains to spread them out well. After having been in this lime twenty-four hours, they are reeled into the second lime,

which should contain the same quantity of lime as the first. The third lime should also contain 1½ lbs. of lime for 100 lbs. of hides; and after being in the second lime twenty-four hours, the sides are reeled into this and are left in the same twenty-four hours. They are then passed into the fourth lime, and after twenty-four hours, are put into the fifth lime. This lime should be warmed to 65° F. before the sides are put in, and should contain 1 lb. of lime for each 100 lbs. of hides. The sixth lime, into which the sides are reeled after having been in the fifth lime twenty-four hours, should contain 1 lb. of lime and 2 lbs. of sulphide of sodium for 100 lbs. of hides. This lime should be warmed to 75° F., the hides being allowed to reman therein for twenty-four hours, when they are passed into warm water, and after being in it two or three hours, they are in condition to be unhaired.

The sulphide of sodium should be dissolved in a barrel and the solution allowed to settle before it is used. The clear liquor is then mixed with lime. Dissolving the sulphide in this way is for the purpose of preventing dark stains on the hides, due to iron in the sulphide. The hides, when unhaired, are washed with running water for fifteen minutes, then placed in water at 80° F., after which they are worked by hand over the beam and then put into the bate.

Liming can also be effected by immersing the hides in a solution of sulphide of sodium, 6° barkometer, for three days, hauling them out each day and plunging the liquor. At the end of three days, the hides are washed with warm water and then limed two or three days, being handled at least twice, and using 2 pecks of lime for every 100 sides. The hides are then washed and bated.

Bating.—The deliming may be accomplished by using any one of the several bating processes that have previously been described. The hides require a clean bate so as to not to become stained, and need to be well bated so as to have a soft and clear grain.

Pickling.—For every 100 gallons of water in the vat use 30 lbs. of salt, and when this is dissolved add 10 lbs. of salt

and 3 lbs. of sulphuric acid for each 100 lbs. of hides as they come from the bate. The hides may be run in the liquor two hours, then left in over night, and drained several hours before they are tanned.

Tanning.—Hemlock and quebracho extracts used in conjunction make an excellent tanning process for bag and case leathers, the liquors being preferably about two-thirds quebracho and one-third hemlock. The sides are nailed on sticks and suspended in a weak coloring liquor for twenty-fours hours. This produces plumper leather than a paddle vat. The sides are then put into a liquor of about 10° barkometer strength. Each day the liquors are strengthened until they are about 30°. When well struck through with the tan the sides are pressed and split. The grains may be retanned in a drum with hemlock-quebracho liquor and then colored and finished. Tanning with hemlock and retanning with a combination liquor is effected as follows: The sides are tacked on sticks and hung in a 7° barkometer hemlock-liquor. They are handled every day for three days, and the strength of the liquor is gradually raised to 10° and then to 12°. After being in a twelve degree liquor twenty-four hours, the sides are put into a combination liquor made of chestnut-wood extract and quebracho extract. The strength at first is 16° barkometer; but this is gradually raised to 20°, taking sixteen days to do it. The leather is next pressed and split, and the grains are then retanned. The retanning liquor should be 3 parts quebracho and 1 part gambier of about 26° barkometer strength and the leather be milled in it one hour, then placed in piles for twenty-four hours, after which it is in condition to be bleached and colored.

Another good tanning process consists of two-thirds hemlock and one-third oak-bark. The hides are first colored in a sour liquor, then put into the tan liquor of 7° barkometer and handled each day, the liquor being strengthened until it is 10° or 12°. When well struck with the tan the hides are pressed and split. Retanning is done with either quebracho and sumac, or with quebracho and gambier. If the former is used

the liquor should be 20° barkometer, two-thirds quebracho and one-third sumac. Running the leather in this liquor one hour accomplishes its retannage, after which it is ready for coloring and finishing.

It is sometimes advisable to drum the sides in a solution of borax and then in an oxalic acid liquor after they are split and before they are retanned, in order to clear and bleach them. The leather is first run in a borax solution for twenty minutes and then washed. It is then run in a solution of 2 lbs. of oxalic acid in 15 gallons of water for ten minutes, then washed free of acid and retanned.

The usual practice, however, is to bleach leather that requires it, after it is retanned. It should not be pressed too hard for splitting, since the more moisture there is in the grain when retanned the better the results will be. When leather is pressed dry for splitting, the grains should be milled in weak liquor before they are retanned and this extra milling prepares them for the retannage. More rapid and thorough penetration results by adding 1 quart of bisulphite of soda to each 6 gallons of retan liquor. Excellent leather is made by tanning the sides in a one-bath chrome process, then washing and retanning, the latter being done with quebracho and chestnut-oak extracts in the proportion of 3 parts of the former and 2 parts of the latter. The liquor should be 12° barkometer at the start, strengthened to 18° the next day, and to 24° on the third day. Each night the hides should be taken out of the liquor and piled down until the next morning, and then be put into the strengthened liquor. After having been retanned for three days, the sides are piled down until the next day, then pressed and split.

Bleaching and Coloring.—Twenty-five to thirty sides, after retanning, make a convenient-sized pack. A solution of 6 lbs. of borax in 25 gallons of water is put into the drum together with the sides and the drum is run fifteen minutes. The temperature of this bath should be 110° F. The leather is next rinsed with warm water and then given a bath of sulphuric acid. Add 2 quarts of the acid to 25 gallons of warm water

and drum the leather in the solution fifteen minutes, when the acid bath is drained off and the leather thoroughly washed until all acid is removed. A sumac bath is prepared by boiling 2 pailfuls of sumac in about 8 pailfuls of water, and the leather is drummed in this thirty minutes, then rinsed in clear warm water, slicked out on the flesh and colored. Some tannages require more bleaching than others. Treatment with sumac is of benefit to any leather that is to be colored. Fat-liquoring is done after the leather is colored. The leather is then drained, slicked out on both sides and tacked on boards to dry.

Finishing Rough Leather.—Rough leather selected for bag and case stock should be of a nice light color, of soft tannage and free from scratches, grubs, salt and bark stains. The best results are secured from sides that measure when finished about 24 feet each, and 14 lbs. weight to the side should be the limit. The rough leather is weighed and trimmed, 25 sides making a convenient-sized pack. Wet the sides down over night and stone them on the jack in the morning. Skive them on the belt-knife machine and split them from 2 to 4½ ozs. per foot. The lighter leather will be the more suitable for suit cases and the heavier for bags.

The next process is washing with borax preparatory to bleaching. If the leather is dark, dirty and greasy, more borax is required than for light, clean stock. Use 25 gallons of warm water and from 2 to 6 lbs. of borax for the 25 sides. Run the leather in this borax solution fifteen minutes. Then drain off the water and wash the leather in warm water to remove the surplus tannin and the borax. The leather is now ready for the acid bath. Mix 1 gallon of sulphuric acid into 30 gallons of water and run the hides in the solution ten minutes; drain the liquor out of the drum and wash the leather with three to four changes of water, using 25 gallons at each change. The leather should be washed until no trace of acid can be detected by the taste in the water coming from the drum. More or less acid may be used according to the requirements of the leather.

Next put the leather into the clean drum together with a strong, hot sumac liquor and drum it one-half hour. Some tanners add a teacupful of tin crystals and a cupful of muriatic acid to the sumac liquor; others add only salt. Take the leather out and place it in piles for twenty-four hours; then rinse it in clear warm water to wash off the sumac and strike the flesh out hard. If the sides are to be colored in a drum, they are now in good condition for the process. If they are to be dried first, give them a coat of cod oil on the grain and tack them on frames to dry. The leather should be run in the color bath thirty minutes, then rinsed and horsed up. One way to treat it is to hang it up to dry after rinsing, without setting it out, as setting-out works the dye into the flanks and sides. When dry the leather may be dampened, set out on the grain, given a light coat of oil and tacked on frames to dry. Another way consists of fat-liquoring rather lightly after coloring, using fig soap and eggyolk in equal proportions; next horsing the leather up for twenty-four hours; slicking hard on flesh and lightly on the grain, then tacking out to dry. When dry, the leather is seasoned and finished. If russet leather is wanted, the leather is taken after rinsing from the sumac bath and finished without coloring.

Finishing.—After the sides are dry, stake them and give the grain a coat of cornmeal filling. This is made by boiling slowly for one-half hour 1 quart of cornmeal in 1 gallon of water. Allow the paste to cool, then strain it and give the leather a good coat, rubbing it in hard. When it is struck in well, roll the leather and hang it up to dry. It is then ready for the seasoning.

The following receipt makes a good waterproof finish for colored bag and case leathers: Put 1 gallon of formaldehyde into a jug, and dissolve in it 3 lbs. of casein; keep the jug tightly corked. Then dissolve 1 lb. of dextrine in 1 gallon of water and add 1 pint of vinette; stir well. Boil 2 ozs. of cornstarch in 2 quarts of water and stir it into the dextrine-vinette mixture. Take ½ pint of the dissolved casein and add it to the finish. Strain the mixture well and apply it to the leather.

Another receipt for a finish is as follows: Boil in 1 gallon of water, stirring until dissolved, ½ oz. 4F ammonia, 2 ozs. O shellac, and 2 ozs. casein. Allow the solution to become cold; then add 1 gallon of water and ½ oz. of glycerine, mixing all together. Apply with a sponge evenly over the leather, and dry it. When dry, the leather is glossed on the machine, then grained, printed or embossed. Equal parts of frozen glue, Irish moss and flaxseed also make a good finish.

For colored and russet leathers the following finish may also be recommended: Dissolve 4 ozs. of blood albumen in 1 gallon of water over night. Cook 4 ozs. of granulated gelatine in 1 gallon of water and let it cool. Mix ½ pint of white varnish shellac with ½ pint of ammonia. Mix these three materials together and add enough water to make 3 gallons. Let this finish stand a week before using it. Apply it with a sponge. For bright finish, dry and glaze. For dull finish, give two coats and roll while wet; then hang up to dry, and when dry give another coat. Finish by graining, printing or embossing.

The following seasoning gives a nice black luster that is lasting: Add 8 ozs. of logwood extract, 1 oz. of bichromate of potash and 2 ozs. of prussiate of potash to 2 gallons of water and boil until dissolved. When cool, strain. To each gallon of the above add 2 quarts of beef blood or of blood albumen. Give one even coat and let it dry; then print, emboss and grain to get the desired figure, or finish smooth as may be desired.

Finishing Imperfect Grains into Patent Tipping.

Among the stock tanned for bag and case leathers upon which a perfect grain is essential, there are found after the hides are split, grains that are imperfect and therefore not suitable for finishing with the more perfect ones. Such grains can be made into patent tipping, upon which, the grain being buffed off, the imperfections are not noticeable. The grains are taken from the splitting machine and washed in warm water to which, for 50 gallons, 1 or 2 lbs. of borax or washing soda to each 50 sides has been added. The leather is

washed in this water for one-half hour, then in cold water for fifteen minutes.

Retanning is done with 15 gallons of one-bath chrome liquor, 25° Bé, added to a barrelful of water. The grains are run in a drum with this liquor for two hours, then piled down over night. The next morning they are washed for twenty minutes in running water. Three quarts of extract of fustic are next dissolved in a half-barrelful of water, and the leather is drummed in the solution one-half hour, after which it is fat-liquored.

Fifty sides may be fat-liquored with 2 lbs. of neutral chip soap and 9 lbs. of the best moellon degras in 50 gallons of water. The leather is run in this fat-liquor one-half hour, then piled down over night. To prepare it for finishing, it is set out and tacked on frames to dry. When dry, it is buffed and staked, and is then in condition to be japanned and finished.

The Manufacture of Lace Leather.

Hides for lace leather are limed and bated in about the same manner as those for upper stock. A fine grain being not essential, sulphide of sodium is used in the lime to hasten the unhairing and to give toughness to the hides. Deliming can be done satisfactorily with lactic acid; and the hides are next pickled with sulphuric acid and salt, and then tanned.

Chrome Lace Leather.—This is made by tanning the pickled sides with one-bath chrome tanning material the same as chrome upper leather, and then fat-liquoring and finishing in the following manner: The leather tanned and neutralized is split. The flesh splits can be finished into gusset splits, into glove leather or into lace leather. The split lace leather is just as durable as the grain leather, but it does not look quite so nice. The sides may be split out of lime or out of pickle, and then tanned with the chrome liquor. Where yellow lace leather is wanted, color it with extract of fustic and some yellow dye before fat-liquoring it. If white leather is desired, wash it in hot borax water and next in water acidulated with

sulphuric acid, and then thoroughly in clean water before fat-liquoring it.

A satisfactory method of tanning chrome lace leather is carried out as follows: The sides are unhaired, bated and washed; they are then drummed with 2 lbs. of pulverized alum and 4 lbs. of salt for each 100 lbs. of hides. The goods carry sufficient water from the last washing to dissolve the alum and salt. When they have absorbed the materials they are allowed to press and drain and, after having been partially dried, are split and shaved. The tanning is then completed by drumming the hides in one-bath liquor in the same manner as for chrome upper; they are finally washed and partially dried for fat-liquoring.

The fat-liquor is made as follows: 4 ozs. of common potash, or other alkali, are boiled in ½ gallon of water; then 2 lbs. of any good degras and 4 lbs. of tallow are added, and the whole brought to a quick boil. The compound requires thorough cooking. Then 1 quart of neatsfoot oil is added and the mixture stirred until the temperature reaches a little below boiling point. The fat-liquor, while hot, is applied to the leather, the quantity named being used for 100 lbs. of it, at 150° F.

When fat-liquored, the leather is struck out and oiled on the grain side with neatsfoot oil, then stretched in frames until dry. After this it is moistened and staked, staking and drying being continued until the leather is soft and dry. Then it is coated on both sides with a light coat of paste made with tallow, starch flour, soap and water boiled together; next it is dried again and finished. The chrome tannage permits the leather to be stuffed at a high temperature, thus insuring thorough penetration of the stuffing grease, and the leather is made very elastic and durable and peculiarly suitable for lace leather. Chrome lace leather does not harden but remains soft and pliable until it is worn out. It does not burn when it goes over the pulleys. The tanning can be done in any of the various methods given for chrome leather.

Fat-liquors for Chrome Lace Leather.—1. In addition to the

one given above two more fat-liquors will be described. For each 100 lbs. of leather use: Moellon degras, 3 lbs.; tallow, 5 lbs.; neatsfoot or cod oil, 2 lbs.; soda ash, 1 lb.

Boil these ingredients in 6 gallons of water for forty minutes; then run in sufficient cold water to make 12 gallons of fat-liquor. Before using it, stir into it 6 fluid ozs. of strong ammonia. Use at 150° F. in a clean drum. Put the leather into the drum together with 15 gallons of boiling hot water and run it ten minutes. This warms the leather so that the grease will penetrate readily. Drain the water out of the drum; put on the door; start the drum and pour the fat-liquor through the hollow axle. At the expiration of forty minutes, take the leather out of the drum and place it over horses for twenty-four hours; then strike it out and oil the grain with neatsfoot or lard oil.

2. Another good formula for fat-liquor is: Soap, 1 lb.; neatsfoot oil, 3 lbs.; tallow, 3 lbs.; carbonate of potash, 4 ozs. These ingredients to be made into 12 gallons of fat-liquor for 100 lbs. of leather which is used in the same manner as No. 1.

Oiling and Finishing.—Set the leather out hard and apply a liberal coat of warm neatsfoot oil to the grain; then tack it on tacking frames to dry. Always stretch the sides lengthwise, as the laces are cut that way. When perfectly dry, take the leather from the frames, moisten and stake it to soften it. Without further treatment the leather is now ready to be cut into laces and for use; but it is of some advantage to apply to the grain a greasy paste, made of tallow, oil and flour. Mix intimately 4 parts of tallow and 1 part of neatsfoot oil, warmed to 130° F. Next stir slowly into the oil and tallow 2 lbs. of flour and allow the mixture to get cold. Apply this liberally to the grain, rubbing it in with a stiff brush. Finally rub the grain hard with a glass slicker to make it smooth and glossy; dry the leather and it is finished. This greasy finish is not really necessary, as excellent leather is made without it; but sometimes a greasy grain is preferred, and in such cases the finishing paste may be used. The splits taken from the tanned hides can be finished with the paste in the manner

described, and will give good service as they are very tough and strong.

Alum-tanned Lace Leather.—The common wooden pail holding ten quarts, is used in measuring the tanning ingredients. Into a clean barrel put 1 pailful of alum and 2 pailfuls of salt; add water, and then boil with steam until the alum and salt are dissolved. Dissolve ¼ of a pailful of carbonate of soda with hot water and pour the solution slowly into the alum and salt solution, which has been added to water in a tan vat, plunging the liquor briskly. Effervescence takes place when the soda solution is mixed with the alum liquor, and when it ceases the liquor, to be in right condition for use, should have a sweetish taste. If the liquor tastes sour, add dissolved carbonate of soda and salt in the proportions stated until it tastes sweetish or neutral.

The liquor should be cold when the hides are placed in it. The tan liquor, having been prepared, place the washed sides into it. Handle them fifteen minutes after they have been placed in the liquor, again at the expiration of half an hour, and again at the expiration of the next half-hour, then at intervals of two hours until the close of day. Frequent handling lays the foundation of an even tan and a uniform grain, two important considerations.

The second day the pack is in the liquor, handle it four times at regular intervals; the third day handle it three times, and the fourth day, twice; and near closing time, haul it up to drain over night, and proceed to finish it the next day.

Tanning may be done also by drumming the sides with the liquor for one day, stopping the drum at intervals, and then starting it again. The pack being tanned and drained, hang the sides up to partially dry. The spots that dry hard should be wet with water and the whole of each side made uniformly moist and soft before grease is applied. Dampen the sides uniformly; fold and pack them in a box and let them remain twenty-four hours, when they are ready to be stuffed. The dubbing used to stuff the leather is made of pure tallow and neatsfoot oil in the following proportions, according to the

time of the year: *In summer time;* 10 lbs. of tallow and 1 lb. of neatsfoot oil, and *in winter;* 10 lbs. of tallow and 3 lbs. of neatsfoot oil. Of course, the leather may be stuffed with tallow only, but the addition of some neatsfoot oil gives it a softer and mellower feel. Half a pound of rosin to 10 lbs. of dubbing contributes to the preservation of the dubbing from oxidation. The dubbing is applied in a fluid state to the sides at a temperature but little higher than the melting temperature of the tallow.

Place the number of sides the stuffing-wheel will carry on a table and spread them out one upon another. With a swab or suitable brush give each side a light coat of the fluid dubbing on both flesh and grain. Place the batch in the cold stuffing-wheel and set the latter in motion. The wheeling should be done in such manner that the sides come into contact with the pins of the wheel in order that the grease may be worked into the leather.

When the sides have absorbed the grease take them out of the wheel and hang them up until they are partially dry. Then with a stone having well-rounded corners go on a table over the sides on the flesh side and straighten them out, when they are ready for shaving. Shave them lightly and evenly.

Then coat both flesh and grain with melted dubbing, and run the sides again in the wheel. Hang the leather up, and when it is nearly dry snuff it over with the currying knife on the flesh side; set the flesh out; stone, slick and glass the grain; oil lightly on the grain and hang up to dry. Then take the leather down and glass it on the flesh and brush it on the grain, and it is ready for use.

A tanning liquor for lace leather may also be made of 15 lbs. of alum, 30 lbs. of salt and sufficient water to cover 50 sides, which are kept in this liquor twenty-four hours. The liquor is then run off, and the sides are given 25 lbs. of alum and 50 lbs. of salt and handled twice each day. They should remain in the liquor two days, and then be hung up to dry. When dry, they are dampened down for two or three days

and then worked out on the staker. To grease the sides, 50 lbs. of white tallow and two quarts of pine tar are mixed and the mixture is applied hot to both sides of the leather. The sides are then put into the drum, heated with steam to 85° F., and drummed one hour. They are next staked on the flesh side, stuffed again as before and then set out lengthwise of the flesh and grain and hung up to dry by neck and tail. Tanning can also be done in a drum in much less time than in a vat or a paddle.

A process that is a little different from the preceding one is carried out as follows: After they are tanned with alum and salt, the sides are hung up to dry. They are however not allowed to dry completely, but are staked while a little damp and then dried completely. They are next stuffed by being given a coat of hot tallow, applied liberally and until the hides will absorb no more. The leather is then run in a dry drum; stretched and after rubbing off the superfluous grease it is ready for use.

A tannage of gambier, alum and salt produces soft, tough lace leather. The hides are suspended in gambier liquor for a few days and then put into a solution of alum and salt. This process produces a thick grain which presents an excellent surface to the buffs. Stuffing is done with hard grease, degras and cod oil. The leather is then shaved, buffed and finally set out, first by machine and then by hand. Tallow and oil are often used in stuffing lace leather, and when the grain is buffed off there is, of course, no liability of its cracking and breaking when in use.

Picker Leather.

Picker leather is used extensively in cotton, woolen and silk mills and great care must be taken in the manufacture of it. It must be soft and mellow so that it can be tied into knots, etc.; and above all, it should be tough so that it will not tear or rip out where loops are cut into it to fasten onto the shuttle. The hides should be of good steer selection, weighing from 50 to 60 lbs. each. They are soaked in cold water in the usual

way, and when thoroughly soaked limed. To every 50 sides use 1 bushel of lime; slake the lime and run it into the lime vats with sufficient water to cover the stock and reel the sides from vat to vat. This reeling must be repeated at least five times during the first ten hours the sides are being limed. When sufficiently limed, that is to say, when the short hair can be worked out, the sides are reeled into water at 100° F. This temperature should be maintained; and the stock again be reeled at the expiration of twenty-four hours. After remaining in this warm bath forty-eight hours, the hides are ready to be unhaired. Fleshing and bating follow, the hides being bated down soft and silky. All the lime should be removed, and the hides should be soft, low and clean before they are put into the tan liquor.

Gambier is preferable as a tannage since it tans quickly and makes soft leather. Oak tannage also produces soft, tough leather. The oak process is as follows: The coloring must be done in vats, with a reel attached, or rather constructed between the two vats, and the sides may be fastened together with S hooks; in fact, they can be tanned entirely in reel vats if the proper attention is given to them. They must be reeled regularly, and the liquor be gradually strengthened until the stock is thoroughly tanned.

Lactic acid used in the first stages of coloring proves advantageous. By proper use of the acid quick tanning results and plump, yet mellow leather is obtained. This method is known as the oak-bark tannage, and it is well to add that when the hides fresh from the beamhouse are put into the liquor, the latter should not be over 2° barkometer, and lactic acid is best employed for plumping after the third day of tanning. Gambier-tanned picker leather is treated in the same manner as oak leather in the first stages of tanning, or until the grain and flesh are nicely struck through with tannin. The sides are then ready for a special treatment, which forms a yellow streak in the center of the hide.

The gambier liquor is made of gambier, alum and salt, about 4 per cent. alum and 1 per cent. salt, and sufficient

gambier to make the liquor show a bright orange color. This bath is heated to 90° F. At the end of one hour draw the sides out and return them to the liquor, and in two hours repeat the treatment, and again in three hours. The following day raise the leather and put it back again. Now let it remain for twenty-four hours, then hang it up and sammy quickly. Put the sides into a stuffing wheel together with all the tallow they will take, say 4, 5, or 6 lbs. until all the tallow has gone into the stock. The sides should now be set on the machine, then reset by hand and given a good coat of dubbin made of tallow and sperm oil, about 60 per cent. of the former to 40 per cent. of the latter. The tallow should be allowed to stand until cool enough so that the hand can be borne in it without pain or until a slight skin arises on the surface of the tallow. The sperm oil can now be added, the tallow being constantly stirred while the oil is poured in slowly. This makes a fine, close dubbin and both oil and tallow will penetrate. Should the oil be added while the tallow is hot it will result in what curriers call "fish eggs", and only the oil will penetrate the stock, which is very undesirable. The leather is then dried and worked out soft and clean.

The Finishing of Splits.

Chrome-tanned Splits.—The splits that are taken off chrome-tanned hides may be finished into gusset splits and glove and mitten leather in much the same manner as the grains. First they should be leveled up on the split side and then shaved and made smooth and clean and of uniform thickness. It is generally necessary to retan them by drumming them first in hot water and next in one-bath chrome liquor for three or four hours, and leaving them in the liquor over night. They should then be drummed thirty minutes, taken out and placed in smooth piles for forty-eight hours. Washing is the next process, which is done in the same manner as grains are washed and neutralized; after this the splits are colored. For black leather a direct black is to be preferred, and direct chrome leather blacks are obtainable that dye a deep, rich black.

There are also special black ooze dyes that are satisfactory for chrome splits, dyeing being effected in one operation and rendering the use of logwood unnecessary. Some dyers, however, prefer to use logwood first and to top off with the direct black. The usual procedure when both dyes are employed is to use 1½ lbs. of logwood crystals and 4 ozs. of fustic extract in 12 gallons of water for 100 lbs. of leather. This liquor is used at 125° F., and the splits are drummed in it thirty minutes. Then 12 ozs. of direct black are dissolved in 2 gallons of boiling water, the solution is poured into the drum and the splits are run fifteen minutes longer. Any suitable striker is next added to the contents of the drum and after ten minutes the dyeing is completed. The use of titanium-potassium oxalate is recommended for this leather. It is given to to the splits after they have been drummed in the logwood liquor. The direct blacks are also used without logwood. A deep, rich black is imperative. The splits should be washed thoroughly after they have been dyed, the water being changed three times. After they have been pressed, they are ready for the fat-liquor. If the leather is for mitten stock and some shade of yellow is wanted, a yellow dye suitable for chrome leather should be used. Special glove dyes are procurable with instructions for their use. For mitten leather the splits are fat-liquored once; for gusset splits twice. Any good chrome fat-liquor may be used. After the application of the first fat-liquor hang the splits up to dry; when dry, put them into the drum together with hot water and drum them forty minutes; then drain off the water and give the leather the second fat-liquor. Let the splits drain over night; then hang them up to dry. To finish them put them into the drum together with warm water and drum them until they are soft and moist, or dip them into hot water and leave them in piles over night. Then tack them onto boards and when dry run them in a dry drum until they are soft; then measure them.

Another way to handle the splits is to mill them after the second drying until they are soft, then to stake them as smooth as possible and measure them. Tacking gets the

utmost measurement and the bag out of them. Splits for mitten leather are handled in the same manner. Softness is, of course, the most essential quality, and is assured by thorough tanning and retanning and plenty of fat-liquor.

Gusset splits are produced not only in black but also in colors, there being special dyes for this work that can be used either before or after the splits have been fat-liquored and dried. Some dyers fat-liquor and color their leather at one operation; but the usual practice is to dye first and fat-liquor afterwards. Dyes that are not stripped from the leather by the fat-liquor are, of course, required. Good penetration of the color is secured by using acid dyes and adding ammonia to the bath, and after twenty minutes drumming to add formic acid to the contents of the drum, which insures uniform color throughout the goods.

Vegetable-tanned Splits.—The splits taken off untanned hides, that is, from hides which are split out of the lime, or out of acid pickle, or out of a pickle of sulphate of alumina and salt, can be tanned in various ways, with extract of hemlock, quebracho, gambier, and finished into innersoling and other leather. Splits taken from limed hides are drenched with lactic acid or some other suitable deliming material, then tacked on sticks and hung in the tan liquor and tanned wholly by suspension. Splits taken from hides full of acid and salt should be first drummed in a solution of 10 lbs. of salt and 6 gallons of water for 100 lbs. of splits for twenty minutes. This puts all parts of the splits into condition to take the tan liquor. The first liquor into which the splits are placed is a plumping liquor made of hemlock extract and should contain at least 10 per cent. of lactic acid to swell the fibers of the splits so that they will absorb the tannin. The splits should then be put into a regular bark yard and worked through stronger liquors, being handled every other day, from two to three weeks being required to tan them, according to their thickness.

Splits taken from hides pickled with sulphate of alumina and salt may be put into weak liquor or drummed therein, and then tanned in hemlock liquors of gradually increasing

strength until they are fully tanned. No salt is needed in the liquors and the alumina or alum is washed out before the tanning is finished.

The most satisfactory way to tan splits is by suspending them in the liquor. Where this cannot be done because of lack of vats, a paddle reel may be used, this being better than a drum. In the paddle there is no violent pounding and the splits therefore finish up finer than when a drum is used. Heavy splits may be put into a 10° barkometer quermos extract liquor in a paddle until they are struck through. They should then be tanned in strong hemlock bark or hemlock extract liquor until they are thoroughly filled and tanned. For light, flexible splits, some softer tannage may be used, such as quermos extract, the first liquor being 10° barkometer. The splits are then passed into stronger liquor or the weak liquor may be strengthened. This method of tanning makes soft splits that require very little oil or fat-liquor.

Before splits that are full of alum or sulphate of alumina and salt are put into extract or bark liquors, it is advisable to drum them in weak gambier liquor until they are softened. They should then be tanned in strong liquors, the alum and salt disappearing before the splits are ready to be finished. The splits should never be washed in water before they are tanned or they will be flat and flabby when finished. Splits are also improved by being drummed in gambier liquor after they are tanned. This has no effect as a tannage but it does improve the texture of the leather. Scouring and cleaning the leather of all dirt and foreign material is also beneficial; or the splits after they are fully tanned and drained, can be rinsed in a vat of water, which will remove any sediment on them. They should never be put into a drum and washed, for this causes them to lose their plumpness and to fall away and become thin. After they are rinsed off they are hung on poles to dry. When dry, they are dampened and stuffed. Rough splits for innersoling are retanned with a mixture of two-thirds quebracho extract and one-third hemlock extract, then rinsed and retanned with sumac in a vat. They are

then partly dried and stuffed, a good stuffing mixture consisting of 1 part tallow, 2 parts soap, 6 parts Irish moss, and 30 parts water. After having been stuffed the splits are set out on a table, and a mixture of 6 parts Irish moss, 1 part starch and 2 parts soap is rubbed in on both sides with a stiff brush. They are then set out with a slicker and hung up flat to dry. A jacking completes the work. Tanners who want to increase the weight of their splits add a little grape sugar to the stuffing mixture.

Splits taken from hides tanned with hemlock, quebracho and chestnut extract in combination process can be worked into Goodyear stock by being trimmed after they are split, and retanned in a paddle with a combination liquor composed of quebracho and chestnut extract. They may a short time be run in a drum with a weak liquor to break up the crust caused by the belt-knife. They are then put into a 16° liquor and left in it forty-eight hours, next placed in piles forty-eight hours; then returned to the liquor for forty-eight hours, the paddle being run about two hours in the morning and two hours in the afternoon. When well filled they are left in piles a few hours and then put into a drum together with the following mixture: For fifty Goodyears use 4 lbs. of flour, 8 lbs. of epsom salts, 1 gallon of cod oil, 1 gallon moellon degras and 10 lbs. of talc, all mixed together into a smooth paste; then add water at 85° F., to make 25 gallons. Run the splits in this solution one-half hour and then put them into piles over night. In the morning set them out very thoroughly; apply a paste made of Irish moss and flour, and hang them up to dry. When dry give them a coat of Irish moss and talc on both sides and roll hard; then dry.

Softening and Stuffing Heavy Splits.—The dry splits require very careful dampening and softening. A good way to do this is to wet one-half of them in water. Then place a dry split on the floor, then a wet split on top of it, then another dry one, and then another wet one until all are piled down. Let them lay two or three days to become uniformly soft and damp, keeping them well covered during that time. Proper

dampening is the secret of soft, well-filled goods. The splits can also be dampened by being sprinkled with water or sprayed with a hose spray and left in covered piles until they are damp and soft; 200 lbs. of dry splits should not weigh more than 260 lbs. when dampened.

The amount and kind of grease to be used depends upon the tannage and must be decided by the workman. Some tannages take more grease than others, gambier and other soft tannages not requiring as much as hemlock and combination tannages. The harder the grease the more can be put in. Sometimes 100 lbs. of dry splits will carry over 100 lbs. of grease, 110 lbs. being the maximum. The grease should be heated to 140° F., and the drum with live steam to the same temperature before the splits are put in. Some degras may be used and a little sod oil, say 10 per cent. of it, but not more, and this only when the grease is very good and hard, or when stearine is used in making the stuffing. The splits, as well as the grease, having been exactly weighed, should be carefully and uniformly dampened and the right temperature maintained during the process. A good stuffing mixture for gambier-tanned splits is made as follows: 6 gallons of brown grease, 4 gallons of common degras and 2 gallons of stearine. If the brown grease is good, use less stearine. Use from 4 to 6 quarts of sod oil to every 12 gallons of the stuffing mixture. If the splits are very hard use ½ gallon more of sod oil to each 12 gallons of stuffing. After having been stuffed, the splits are finished by being whitened, blackened with soap and lampblack, dried, trimmed, given a paste of flour, dried, rolled or glazed and covered with a size made of gum tragacanth, dried again, sorted and graded.

Stuffing for Wax Splits.—To make 100 lbs. of stuffing grease, take 45 lbs. of tallow, 10 lbs. of degras, 25 lbs. of stearine and 20 lbs. of paraffin wax. Dissolve the stearine and wax; add the tallow and then the degras. Use from 35 to 40 lbs. of the stuffing to 100 lbs. of dampened splits. Heat the drum to 135° F., and the grease to the same temperature. Let the drum run twenty minutes with the door closed and ten min-

utes with the door open. Hang the splits up until they are well cooled off and good and stiff; next set them out tightly on the back and then on the face side, and hang them up to dry.

Another receipt for stuffing is: In a suitable kettle heat hard glucose to 140° F. In another kettle place one-half degras, one-half brown grease and one-third best stearine and cook thoroughly. Use about 12 lbs. of glucose with 40 lbs. of combination grease, mixing just before using. The glucose gives good color and weight, but it must be used carefully and with judgment. If the splits are too wet or too dry or of hard tannage no stearine is necessary, good brown grease and degras and glucose being under such conditions sufficient. Dampening for stuffing should be done in such a manner that 300 lbs. of splits take an additional weight of 35 lbs.

Finish for the Black.—When splits are dry after stuffing and setting out, pack them down in a pile for a few days; then whiten lightly on the back and to a fine face on the side to be finished. Now trim the edges and place the stock flesh-side up on a table for the back finish. Make a paste for the back finish by mixing together 2 lbs. each of red lead and yellow ochre and pour in slowly one gallon of cold water; stir while pouring. Dissolve 1 lb. of corn starch in 1 gallon of cold water. Boil the lead and ochre and pour in the starch, stir well and boil thoroughly. Let the finish cool and it is ready for use. Spread an even coat of it on the flesh with a soft brush. Hang the stock up to dry and then glass with a jack. If the paste is too thick add more water; and if it is not the color that is desired, change the proportions of lead and ochre to suit.

Soap Black.—To make a soap black, dissolve 12 lbs. of common soap in a half-barrelful of water together with 2 lbs. of common potash. Add from 12 to 15 lbs. of lampblack according to quality. Boil slowly after the black has been mixed in. Next add two pailfuls of strong logwood liquor and 1 lb. of indigo or Prussian blue and boil and stir thoroughly; then fill the barrel with cold water and add 1

pint of muriate of iron. Spread this black with one brush and rub it in with another. Sweep any smut off with a duster. If the glassing is to be done by hand, glass right after blacking. If the stock is glassed with a jack, hang the splits up after blacking before glassing. When the black is dry they are ready to be jack-glassed.

Flour Paste.—For pasting make a stiff flour paste by mixing 4 quarts of flour in 2 gallons of cold water. Put in a little water at a time and stir to keep lumps from forming. When thoroughly mixed, boil for ten minutes with live steam; then add ½ lb. of tallow and ½ lb. of common soap. Boil until thoroughly cooked. Let the paste cool and spread on a fairly heavy coat of it evenly with a fine sponge. Hang up the splits, and after the paste is dry, glass either with jack or by hand. If the splits will stand it they can be oiled over the most solid parts on the black side. Good judgment must be used in oiling so as not to have the stock show the oil after it is finished, as heavy mill-stuffed leather will not stand much oil in finishing.

For finishing give an even coat of gum-tragacanth dissolved to a thin substance. When dry, the splits are ready to be sorted.

Finishing Splits into Goodyears, Chair Splits, Etc.—The splits are taken from the splitting machine and trimmed, then put into a mill with a weak tanning liquor of 6° to 8° barkometer, and milled one hour. This milling breaks up the crust made by the belt knife and opens up the splits so they will take the retan liquor. When milled they can be retanned in a mill or put back into the tan yard for three weeks in strong liquor. The splits should be pulled out of the liquor every other day and allowed to drain for from four to six hours, the liquor strengthened up, and the splits put back one at a time. If the tanning is done in a mill it will take about six days to make a good split. The splits should be milled in strong liquor about two hours each day and then left in piles the remainder of the day. This operation is repeated daily for six days when the splits will be fully tanned.

When tanned, the splits are sorted and the heavy ones may be worked into flexibles or Goodyears, and the light ones into chair seats.

If flexibles are to be made, the splits are put into the mill (after lying 48 hours after the last tanning) and given a milling in a strong solution of epsom salt. This gives them a light color without removing any of the tan. The epsom salt solution is made by dissolving 75 lbs. of the salt in 50 gallons of water. Use about 12 gallons of the solution to eight splits. Drum then in it thirty minutes, then pile them down over night. The next day set out and hang them up to dry. When dry, dip the splits in warm water and lay them in piles twenty-four hours; then give them a coat of Irish moss and soap and roll hard and hang up to dry. When dry, trim and measure them.

If Goodyear splits are to be made, the splits must be trimmed so as to have the proper bend for goodyears. The trimmings are finished in the same manner as the flexibles and sold for cheap insoles; then the bend is leveled up on the splitting machine. Bends for Goodyears must be of uniform substance. After they are leveled they are fat-liquored with soap and cod oil, using ¼ lb. of soap and 3 lbs. of oil to each 100 lbs. of leather. Run them in the fat-liquor and pile them over night. Now make up a clearing liquor of 2 lbs. of lactic acid in 16 gallons of water, and run the bends in this ten minutes; then dry them out, taking pains to have them dry flat.

When they are dry, make up a paste of 3 lbs. of frozen glue, 1 lb. of white soap, 1 lb. of Irish moss and 1 quart of finishing oil. Soak the glue over night in 3 gallons of water. In the morning add the soap and moss and oil and boil for an hour, then add enough water to make 10 gallons, and strain. When cold, give the splits a good heavy coat of it and hang them up until the paste is struck in; then roll the splits hard and treat the other side the same way. When dry they are finished.

If the light splits are to be put into chair splits they are leveled on the machine, then put in a mill and given a mill-

ing in sumac liquor, using 1 pailful of sumac in 12 gallons of water for one dozen splits. Mill the splits for one hour; then pile them down twenty-four hours, and set out on both sides and hang up to dry. Do not hang over sticks. Trim off all the shanks and thin edges. When they are dry, make up a a filling paste of ½ lb. of corn starch, ½ lb. of dextrine, 1 lb. of casein that has been soaked over night in 3 gallons of water, and boil this mixture slowly for an hour. While it is boiling add ½ lb. of ivory soap cut into fine shavings. This will make 10 gallons of paste. Aniline dye of any color desired can be added to the paste and the splits made into any color. They should be given a good coat of this paste. It should be put on smooth and when about half dry, the splits should be rolled hard and dried, and they are then in condition to be embossed. After embossing, they are given a coat of waterproof finish made by cutting up shellac or casein and adding aniline soluble in spirits, to the finish; by using aniline of the same color as the splits the finished goods will have a much richer color. These splits are often worked into cheap suit-cases and bags.

White Splits.—Where a soft white split is wanted a tannage of sulphate of alumina may be used. If the sides are split out of the limes, the splits should be bated and pickled with sulphuric acid and salt the same as grains or whole hides; they are then in condition to be tanned.

The tanning liquor is prepared by boiling 12 lbs. of sulphate of alumina in 10 gallons of water, and then adding slowly to it 24 ozs. of bicarbonate of soda dissolved in 1 gallon of water. The soda should be added slowly and the liquor stirred constantly. The pickled splits are weighed and thrown into the drum. For each 100 lbs. of them 10 gallons of water, 1 lb. of Glauber's salt and 3 lbs. of common salt are thrown into the drum and the splits are drummed with the solution twenty minutes, the liquor being then drained off. Ten gallons of lukewarm water to which 5 lbs. of salt have been added are run into the drum and the splits drummed fifteen minutes. Half of the previously prepared alumina-soda liquor is then run into the drum and the splits are run in it three

or four hours, then horsed up to drain over night and hung up to dry the next morning. When dry they are drummed with 8 gallons of water for ten minutes. The rest of the alumina and soda solution is then run into the drum and the splits are run three hours longer; they are then drained again and hung up to dry.

Finishing consists of drumming the splits with a solution of sulphonated oil, 7 lbs. of it being used in 8 gallons of warm water for 100 lbs. of dry splits. Some flour may advantageously be added to the oil solution. When the leather has dried again it is staked and run in a dry mill until it is perfectly soft. The solution of oil may be added to the tanning liquor, which saves the labor of the extra fat-liquoring.

Formaldehyde also produces white leather. The splits are tanned in a formaldehyde liquor the same as grains and sheepskins, then neutralized and fat-liquored with soft soap or sulphonated oil, dried and finished.

Formula for Making Grain Leather from Splits.—Imitation grain leather may be made according to the following instructions: The splits should be run through a borax bath in a drum, 5 lbs. of borax dissolved being sufficient for twenty-five splits, medium size and weight. Heat 8 gallons of water to 75° F., and drum twenty minutes. Then make a bath of sulphuric acid of 8 gallons as sour as a lemon. Drum the splits in this fifteen minutes, then rinse in clean cold water. Run in plenty of clear cold water until the acid is all soaked out of the goods, then fat-liquor with 5 lbs. of chip soap and 2½ lbs. of neatsfoot oil. Boil the soap in 3 gallons of water and add the oil together with 1 oz. of sal-soda. Cool to 80° F. and run the goods thirty minutes; then horse them up to drain. Next slick hard on both sides and glass on split side. Oil with linseed oil; then hang up or tack out to dry.

When dry the splits are ready to receive the color, black or brown or any color that is wanted. When colored and dry, they are ready for the moss or linseed solution. A good dressing is made from equal parts of glue and gelatine. Apply when warm, taking care not to have it too thick and to spread

it on evenly. After the dressing has dried, the goods are embossed either in imitation of some grain or plain. This is a very necessary operation. After it has been done, the embossed side is given a coat of waterproof filling which is made of wax and rosin dissolved in turpentine; this is the final finish and the leather is now ready for use.

A PROCESS OF DRUM TANNING FOR SOLE AND BELTING LEATHERS.

Drum tanning is a safe and rapid way to produce sole and belting leathers. In using quebracho, 85 per cent, and oak, 15 per cent., a first-class piece of leather can be made by carrying out the following process: After putting hides through the beam shop, for handlers hang the hides in a 4° liquor made of quebracho and oak extract as mentioned above. In preparing liquors, mix and let the liquor stand from five to six days in coolers or storage vats to sour. Put 3000 gallons of 4° liquor into the cooler, 4 gallons of acetic acid and 1 gallon of dermiforma. After standing five or six days, run the liquor on green hides. Strengthen each day with enough liquor to fill rocker for green hides in turn. Raise the liquor 3° each day until the strength is up to 20° barkometer. Add every day 1 gallon dermiforma and 6 quarts of acetic acid. Then feed from head rocker, keeping liquors at 20° to 22°. Never have the tail handler over 4°, as quebracho extract penetrates much faster than oak extract. It is safe if tail handler falls to 3°, but it is best to keep it a 4°. There should be ten rockers in a section, and the hides should hang twenty days. Then take them from the rockers and crop them for the drums.

Put fifty backs in a drum, fill the drum two-thirds full with 75° liquor and run for forty-eight hours without changing the liquor, but watch the heat and keep it below 105° F. After the forty-eight hours are up, run out all the liquor and fill again with 75° extract, filling the drum only half full this time. The drum should be large enough to hold 25 barrelfuls when half full. Drum twenty-four hours, and the hides will be tanned throughout, plump and of fine color.

The hides must be toggled well together, grain inside, so as to prevent the grain being damaged by rubbing together. After seventy-two hours run, take the leather from the drum and lay it away in a 75° liquor for four days. Put three hundred backs in a vat eight by nine by six feet deep, using 50 lbs. of sumac to 100 backs; on the fourth day raise the stock and run it through a wringer and put it back into the drum. Put in 3½ lbs. quebracho extract, dissolved and not diluted, to each back. Put fifty backs into the drum and 175 lbs. of extract and drum thirty minutes. Then take from drum and throw in a sour liquor. It will be found that by running the backs through the wringer or press, the extract will penetrate much better and very little will remain on the surface. The sour liquor should be 25° to 30° barkometer. After laying in the sour liquor for twenty-four hours, the leather is ready for bleaching. It is advisable to scour lightly on the grain. Have one box holding 750 gallons of water and two soda and two acid boxes. Put 22 lbs. soda ash in the first box and 3 lbs. of it in the second box. Put 30 lbs. of sulphuric acid in each box and heat to 125° F. Hang eight backs in each box; strengthen after every forty backs, putting 4 lbs. soda in first box, but none in the second, as pulling stock from first to second will keep all the soda required in the second box. Also put 4 lbs. of acid to each box for every forty backs. Take them from the box and put in clear water for two hours; then oil, and put the leather through the press or hang it up to drain, preferably the latter as the press draws more or less extract to the surface. For oiling use ¾ lb. of cod oil or a mixture of cod and mineral oil. As to sugar and glucose, putting it in with the oil and drumming it in, is the cheaper way, but the best results are obtained by retanning.

When dry, dip the leather into water for rolling. Prepare it in the usual manner and roll it. If properly looked after in the rolling room, the backs will look just like vat-tanned oak backs, only they will be firmer and of a brighter color. From 70 to 75 per cent. finished grains can be made by this process.

SECTION EIGHT.

Processes, Receipts, Formulas and Notes.

NOTES AND SUGGESTIONS ON CHROME TANNING.

A Practical One-bath Chrome Liquor.—A chrome liquor that may be used for tanning hides and skins of any description is made as follows: Dissolve 10 lbs. of bicarbonate of soda in 2 gallons of water. Add to the solution 10 lbs. of sulphuric acid; then add slowly 6 lbs. of syrup glucose, in portions, waiting after each addition of the same for the agitation to subside, before adding the next portion. This liquor when diluted to 45° Bé. will contain 10 per cent. of chromium oxide and 15 lbs. of it will be required to tan 100 lbs. of skins. It is an advantage to add a certain quantity of Glauber's salt or of common salt to the liquor, to give the leather more spread, and to make it soft and pliable.

A Chrome Alum Tanning Liquor.—A simple chrome liquor that has been used in practice is made of chrome alum and soda crystals in the following proportions: Dissolve 10 lbs. of chrome alum in 8 gallons of water, and 3 lbs. of soda in a little boiling water, adding enough cold water to make 1 gallon of solution. Add sufficient of the soda solution to the chrome-alum liquor until a clear liquor results; then add a small quantity of salt. Ten gallons of liquor made of 10 lbs. of chrome alum will tan 100 lbs. of skins. Chrome leather becomes fuller and finer the more nearly the chrome-alum solution approaches the point of precipitation. Salt tends to give the leather a soft feel and the grain a fine break, and soda to give fullness. When no salt is added, the leather is close and tight, lacking softness and elasticity. Overtanning and the use of too much salt makes the leather soft and spongy.

A Method of Neutralizing Chrome Leather.—When borax, which is a good neutralizer and cleanser, is used, the boric acid that is liberated must be washed entirely from the skins, or else trouble will ensue in the coloring of the leather. If sodium phosphate is used the phosphoric acid unites with the chromium, forming chromium phosphate, which is insoluble in water and also in very weak acids that might be employed in dyeing. In order that the free phosphoric acid may be removed something has to be employed that will produce the result, and not effect a detriment to the skins.

This is best accomplished by the use of bicarbonate of soda; and the process is most suitably carried out in water at 90° to 100° F. Very good results have been obtained by using from 2 to 3 per cent. of sodium phosphate of the weight of the skins for the first bath. Then allow this liquor to run off, after which put in about .05 per cent. of the sodium bicarbonate and run the drum fifteen minutes, the temperature of the water being about 80° F. The first bath in which the sodium phosphate is used should be of the same temperature, and the drum be run from thirty to forty minutes. When using this process the tanner must remember these figures do not apply to all classes of skins, and the quantities have to be varied with their quality and condition. Borax, if used, should be well washed away. The two chemicals mentioned above are cheaper than borax.

How to Retan Chrome Leather.—Light skins do not require retanning, except lightly with gambier or sumac as a base for subsequent coloring. A light retannage with some vegetable tan is also good for black leather since it gives a fine grain, deeper black and better finish. Hides that are to be split after tanning, should be tanned in a paddle wheel or suspended in the liquor in a vat, and then be pressed and split. When pressed, mill them in a dry mill until they are opened up and ready to split; then jack them the same as for bark splitting. After splitting, the grains almost invariably need shaving and retanning. For each 100 lbs. of leather, dissolve 5 lbs. of salt in ten gallons of water and drum the leather in this solution

ten minutes. Then add 3 quarts of chrome liquor and drum three or four hours; horse the leather up for twenty-four hours and wash it in the usual manner. The grains can be colored blue while they are being retanned by adding to the chrome liquor sufficient nigrosine and drumming as directed. Subsequent dyeing with logwood or direct black is necessary as the nigrosine simply colors the flesh and prepares the grain for the subsequent blacking. Chrome leather that dries out hard because of imperfect tanning can be somewhat improved by being drummed in a strong, hot solution of salt and then in chrome liquor, washed, fat-liquored and dried. Tacking on boards to dry is necessary to stretch the grain smooth and to draw out the wrinkles caused by retanning.

The more thoroughly grains and skins are tanned the more easily they will color and finish and the more satisfactory the leather will be when finished.

A Method of Drying Chrome Leather before Coloring and Finishing It.—By applying the following process to the skins after they are fully chrome tanned, it is possible to keep them in the dry or crust condition as long as it may be desired to do so and then to color, fat-liquor and finish them into marketable leather:

The skins, upon being taken out of the tan bath, are horsed up over night, without being washed, and the next day are set out and shaved. They are then weighed. A bath is prepared with 4 lbs. of standard lactic acid in 15 gallons of water for every 100 lbs. of wet leather. The goods are run in this bath for ten minutes, when they are taken out and sent to the drying loft and dried out. They may also be dried tacked on boards or in frames. When dry the skins can be stored away until wanted, and be sorted into grades and weights as required.

The dry leather when treated in the manner described, absorbs water readily and assumes its original wet condition as it was when it came from the tan bath. It can be washed thoroughly without any fear of removing valuable tanning salts or of interfering with the character of the leather.

After the skins have been washed back in a drum, the operations of dyeing and fat-liquoring may be immediately proceeded with; the leather is then dried and finished.

In combination tannages of chrome and vegetable tannin, the fixation of the latter is brought about more intimately by treating the stock after the chrome bath with a bath of lactic acid. The result is a leather superior to either of the tannages employed independently. The application of this process to chrome-tanned leather results in permanent fixation of the chromium base and a consequent improvement in the quality of the leather.

To Increase the Suppleness of Chrome Leather.—When heavy chrome leather is required soft and supple and yet must not contain much grease, as for example, for automobile tire leathers, the method recommended by Professor Eitner is satisfactory. In the ordinary method of chrome tanning by the two-bath process, sulphur is deposited in both the liquor and the fibers of the leather and when thus deposited in the fibers it produces softness and suppleness.

A method for increasing the amount of sulphur deposited in the fibers is as follows: In the first bath, for every 100 lbs. of pelt, take 3 lbs. of chrome alum, 1 lb. of bichromate of potash and 2 lbs. of hydrochloric acid. In the second bath only hyposulphite of soda is used to the extent of 8 lbs. No acid is added, as there is sufficient in the goods to produce the desired effect. By this means the sulphur is deposited in the fibers, the result being a very soft, supple leather. It is of a green color, but if it is desired to make it whiter the following plan may be adopted: The goods are first pickled for one or two hours, with 1 gallon for each pound of pelt of a solution containing 20 per cent. of salt and 5 per cent. of sulphuric acid, and 4 per cent. of bichromate of potash is then added. This constitutes the first bath. The second bath contains only hypo.

Ordinary one-bath leather can be made to represent two-bath leather by incorporating sulphur in the fibers. Before the goods are tanned they are treated alternately with hypo

and with hydrochloric acid, then tanned by the ordinary one-bath process. This method produces a chrome leather with a large amount of free sulphur which makes it very supple. The process can be carried out in either direction, or even repeated more than once, i. e., either hypo first, followed by hydrochloric acid and salt, or vice versa.

To Dissolve Chrome Alum.—Several substances that are used in the tannery have the peculiarity that while being fairly soluble in water, they dissolve very slowly. For example, chrome alum is soluble to the extent of 1 part of chrome alum to 7 or 8 parts of water, but it dissolves very slowly. If a solution of chrome alum be used, in which some crystals remain undissolved, there is danger of stains or uneven results being produced by the contact of the solid particles with the skins. In this case it is better to make up the solution some time in advance, so as to be sure that all the crystals are dissolved. When this is impossible, or where the solution is required immediately, it is better to adopt some other means than merely stirring the crystals in the bottom of the vessel. A better way is to suspend the chrome alum in a basket, coarse bag or some sort of strainer in the water so that the crystals are in contact with the water at the top of the vessel. By this means the alum is much more quickly dissolved, because, as it dissolves, the solution falls away from it by gravity, thus exposing a fresh portion of the crystals. If the solution of chrome alum is to be used in the drum, then, of course, it may be dissolved in the requisite quantity of water by agitation in the drum. With some substances which dissolve slowly it is possible to hasten the solution by using hot or boiling water, but in the case of chrome alum, the solution thus obtained is different from that in cold water, the latter being of a violet color, while that in hot water is green-colored.

The two solutions differ chemically in the extent to which the chrome alum is hydrolized, and theoretically, one would expect the violet-colored solution to produce better tanning results than the green one, but the tanning effects are generally

the same in both cases. In experimental cases two similar packs of calfskins were tanned in the two different colored solutions (made basic with soda), and after being tanned were neutralized, fat-liquored, dyed and finished, but with no apparent difference in the result. It was therefore concluded that it is not worth the time and trouble to make the violet-colored solutions.

A New Process of Chrome Tanning.—The modifications of the ordinary chrome processes of tanning are almost legion, particularly so in connection with the production of one-bath chrome liquors. For the production of the latter there are two general types of method, the first involving the use of a chromium compound, such as chrome alum, which is rendered basic by the addition of some alkali, such as soda. The modifications in this branch include the use of different alkalies for rendering the salt basic, and also the use of different classes of chromium compounds. The most common, of course, is chromium alum, of which the active constituent is chromium sulphate. Other chromium salts which have been advocated are chromium formate, chromium acetate, and chromium chloride.

In the second type of method for the production of one-bath chrome liquors, bichromate of potash or soda is taken, and reduced by some reducing material. The chief modification in this class of process rests in the agent which is used for the reduction, both organic and inorganic materials having been employed. Of the organic materials probably the most common and the most widely used have been cane sugar, glucose, glycerine and alcohol, while the inorganic materials include bisulphite of soda and hyposulphite of soda.

According to a recent German patent taken out by M. F. Hirch, the reduction is carried out by means of a solution of bisulphite of alumina, which, it is claimed, has the following advantages over hypo or bisulphite of soda:

There is no deposition of free sulphur as with hyposulphite of soda, and no great evolution of heat as with bisulphite of soda. The deposition of aluminum hydrate is formed in the

skin. The reduction should be carried out without the addition of acid. If a solution of bisulphite of alumina of about 14° Bé. be added to a 2 per cent. solution of chromic acid, the complete reduction of the chromic acid is attained without any precipitation. If, on the other hand, a solution of one-third the above concentration be used, the reduction of the chromic acid is complete, but at the same time a precipitation is produced in the liquor.

The first method of use, that is, with the concentrated solution of bisulphite, is suitable for tannage in one bath, while the liquor produced by the use of the weaker bisulphite solution is suitable only for the tannage in two baths. The following is given as a practical example: The skins, unhaired, delimed and pickled as usual, are submitted to the following treatment: The bath consists of 5 per cent. of bichromate of potash, 2½ per cent. of hydrochloric acid, 180 per cent. of water, calculated on the weight of pelt. The goods are allowed to turn in this liquor for three or four hours and are then placed in a pile for twelve hours. Finally they are transferred to the second or reducing bath.

This bath consists of 36 parts of solution of bisulphite of alumina of 14° Bé. and 220 parts of water for each 100 parts of pelt. The goods are turned in this liquor for four hours, when the tannage should be complete, with the grain even and smooth. The leathers tanned by this process are more resistant than those produced by other processes, and can be dyed more easily and more regularly, partly because the deposition of sulphur is avoided and partly because the alumina forms a mordant which is very favorable to dyeing.

The Recovery of Chrome Residues.—In the two-bath method of chrome tanning, the first bath, which consists of an acidified solution of bichromate of potash or of soda, is never fully exhausted. It has frequently been proposed to utilize the residual chrome in this bath by making use of a standing bath, that is, never wholly discarding a bath, but adding to it each time a quantity of bichromate and acid sufficient to restore its original constitution. Unfortunately this renewal of the bath is an extremely complicated matter.

It is probably more practical with our present knowledge not to try to again utilize this chrome in tanning and by so doing produce a poorer quality leather, thus saving at the spigot, as it were, and losing at the bung, but to recover the chrome in some form which will make it available for some other purpose.

Two processes for the recovery of chrome as a by-product have been proposed, both of which can be worked profitably, provided proper care is taken and the work of the tanner is on a sufficiently large scale to warrant expenditure for labor.

The first process consists of the precipitation of the chrome as chromate of lead or chrome yellow. There is an extensive demand for this pigment, and the particular shade is not of great importance so long as it runs strictly uniform. In order to obtain uniformity the precipitation should be always made under as near the same conditions as possible, and to obtain brilliancy the solution should be filtered before precipitation takes place, and some alum be added as a clarifying agent. White sugar of lead should be used for precipitation. A filter press is absolutely essential to collect the precipitate. The product may be dried or sold in the pulp form to mixed paint manufacturers. The price obtained for the chrome yellow depends upon the care with which it is made, but with ordinary precautions taken this working-up of a by-product is fairly remunerative.

The second method of utilizing the waste chrome is to reduce it with sodium bisulphite or sulphurous acid gas, precipitate with soda ash, collect in a filter press the chrome hydrate so formed, wash it thoroughly, and use it in the manufacture of one-bath tan liquors. This method is in many ways preferable to the manufacture of chrome yellow, as it does not involve the looking for an outside market with its attendant bothers. In order to conduct even this recovery of chrome profitably, the liquors must be analyzed and no great excess of reducing agents or soda be employed, otherwise these chemicals may be wasted and no real gain be obtained.

DEPILATORY COMPOUNDS FOR WOOLSKINS AND HAIRSKINS.

The present methods of removing wool from sheepskins and the hair from goatskins and other light skins are considerably different from the old-time process of sweating and liming, the latter having been replaced by the method of painting on the flesh side with mixtures, of which lime is mainly the base. These mixtures usually contain lime and some sulphide, such as sodium sulphide or arsenic sulphide (red arsenic). By mixing lime with either of these substances, and with the addition of water, a paste is obtained which, when applied to the flesh side of the skins, causes the hair or the wool to be loosened in a few hours. Methods of mixing lime and the sulphides vary. It is usually held as good practice either to slake the lime with a solution of sodium sulphide, or to mix the lime with the sodium sulphide first, and then to slake with water, or in the case of arsenic sulphide and lime, to place the two in alternate layers and then slake. The high temperature caused by the slaking of the lime produces a reaction between the sulphide and the lime, so that hair-removing compounds are formed.

As a type of method, the following, which has been recommended by the Light Leather Trades' Federation of Great Britain, may be given:— 7½ lbs. of sulphide of sodium crystals to every 40 lbs. of dry lime are the desired proportions for all skins. Take the 40 lbs. of lime, slake in 9 gallons of water, and allow to stand for three days, so that all the hard substances are well slaked. Pass the slaked lime through a sieve with a mesh ten to the inch. Dissolve the 7½ lbs. of sodium sulphide in 1 gallon of water. Add the sulphide solution to the lime and mix well. The mixture is then ready for painting the skins, which should be pulled not later than the next day. As they are pulled they should be washed in clean water before they are put into weak lime. The gathering limes that are used should be cleaned out at least once a month. On no account should the skins be put into the weak lime before being washed to remove the sulphide.

A suitable depilatory paint for all classes of skins is pre-

pared as follows: 60 lbs. of unslaked lime; 25 lbs. of sodium sulphide; 20 gallons of water. For slaking and mixing a wooden tub should be used. A thin layer of the unslaked lime is then placed on the bottom of the tub, and on this a thin layer of sodium sulphide crystals, followed by a further layer of the lime. The two ingredients are thus placed in alternate layers until the whole amount of each has been placed in the tub. The necessary amount of water to effect thorough slaking is now added a little at a time; about 10 gallons of water will be necessary for the amounts of lime and sulphide given above. After slaking, the mixture should be left overnight, the remaining 10 gallons of water are then added, and the mixture is thoroughly stirred. Before being applied to the skins, it is recommended to pass the mixture through a fine mesh sieve, in order to remove any small lumps of unslaked lime, stones, etc.

For the finer grades of leather, such as lambskins and goatskins for glazed and glove leathers, upon which fine grain is essential, the use of paint composed of lime and red arsenic is to be preferred. It is usually recommended to mix the arsenic sulphide and the lime before slaking, so that the heat produced by the slaking of the lime causes the production of the calcium sulphydrate. M. C. Lamb has given the following method: "The arsenic sulphide is mixed with the unslaked lime in a suitable receptacle, in alternate layers of lime and arsenic, and the amount of water necessary to effect the slaking is then poured over the mixture. Suitable quantities to use are: Lime, 120 lbs.; red arsenic, 30 lbs.; water, 60 gallons.

"After the slaking has been performed, the mixture should be thoroughly mixed up with a wooden spade, and diluted to the required consistency by the addition of 45 to 50 gallons of water. The paint should be allowed to stand over night before using and may with advantage be passed through a fine mesh sieve before being applied to the skins. When properly prepared the paint should be pale green in color. Any trace of red or pink color is evidence that the mixture is not satisfactory, and that the necessary chemical reaction during the slaking process has not been satisfactorily effected."

Any one of the above described depilatory paints may be used upon wool or hair skins for any tannage with perfect safety and satisfactory results. A liming for a few days usually follows the depilation with one of these prepared paints.

THE CONSERVATION OF SKIN SUBSTANCE.

It must appear evident to anyone engaged in the hide and skin business that there is continual loss of substance and depreciation of value in a skin from the moment it is taken off the animal until it is finally converted into leather. The principal reason for this loss is the presence of liquifying bacteria, which bring the gelatine of the skin into solution. The conservation of this material is of vital interest to the tanner, and should also demand the attention of the skin collector and dealer. With this end in view experiments were conducted for a number of years to discover some inexpensive method of conserving the substance of skins, especially calfskins, without any detrimental effect.

Of all the materials tested, zinc chloride has been found to best prevent this liquifaction and consequent loss and deterioration without producing any results, visible either in the skin or in the finished leather, that are in any way objectionable.

The method of using zinc chloride which has given the most satisfactory results is as follows: The fresh skins are first salted in clean, coarse, solar salt for the purpose of withdrawing the blood from them, and are allowed to remain in a low, narrow pile for from twenty-four to forty-eight hours. They are shaken out of this first salt, which is taken to the refuse pile and is thereafter used only for salting the trimmings, and placed in a pack, and to the salt which is used for this second salting, zinc chloride is added. For convenience, a stock solution of 1 lb. of zinc chloride to 1 gallon of water is made. To a barrelful of water add 1 pint of this solution and stir thoroughly. The salt which is intended for the second salting is sprinkled with this zinc chloride solution until a quantity taken in the hands and pressed oozes moisture. The salt treated as above is thrown on the skins in the usual way.

Fresh skins treated in this manner lose practically no gelatine and remain fresh and clean so long as skins are ordinarily held. The treatment is also valuable in conserving skins that are shipped in. In a case where skins show a tendency to hair slipping or have become heated, it is advisable to first dip them into a solution of the zinc chloride made by adding 1 pint of the stock liquor to a barrelful of water, and salting as directed for the second salt. The results obtained from handling hair-slipped skins in this manner are remarkable. The zinc chloride instantly checks the liquifaction of the bacteria and the leather produced from the skins is the equal of that made from perfect ones. Comparative experiments with cold-storage methods have also been made. One lot of skins was kept at a temperature of 30° F., another at 0° F. At the same time skins were put in pack by the zinc chloride method. The skins were all held for one year. Those treated in zinc chloride were in every way equal to those kept in cold storage; and the leather produced from the zinc chloride treated skins was equal to that made from strictly fresh stock.

A general following-up of the above suggestions will do much toward conserving the most valuable constituent of the raw skin. The method is not an expensive one, zinc chloride costing only about thirty cents a pound. It is best bought in pound bottles, as it is deliquescent.—Carl E. Schmidt in the Shoe and Leather Reporter.

DRYING SKINS IN PROCESS.

Nearly all classes of skins are pickled nowadays before they are tanned since they tan better in pickled, than in the unpickled, condition. Pickling helps materially in getting soft light-colored and well tanned leather, another advantage in pickling being that skins so treated can be kept a long time without spoiling before they are tanned. The two processes of pickling that are commonly used are pickling with acid and salt, and with sulphate of alumina and salt, the process being usually applied by drumming the skins in the pickling liquor. The pickled skins are then packed in barrels or boxes and kept until it is desirable to tan them.

A good way to treat skins that have been pickled with sulphate of alumina and salt consists in drying and keeping them in the dry condition until they are to be tanned. Hides treated in this manner can be wetted back at any time, and split and tanned.

Light skins can be moistened and softened and then shaved and tanned by a chrome process. There should be from 10 to 15 gallons of pickling liquor for 100 lbs. of skins and from 3 to 6 lbs. of sulphate of alumina and from 6 to 10 lbs. of salt. Heavy hides should be given the larger quantities, light skins the lesser. The hides or skins are put into the drum together with half of the solution and run ten minutes, then the rest of the liquor is poured in and the drum is run ten minutes longer. After having drained several hours the skins may be hung up to dry, if it is not desired to tan them at once. When they are to be tanned they may be softened with warm water, then drummed in cold salt water until saturated, and then tanned with one-bath chrome tanning liquor.

Chrome-tanned skins are usually dyed and fat-liquored before they are allowed to dry, as dry chrome leather does not readily take color and grease. A practical method of drying chrome leather before coloring when it is considered advisable to do so, consists in drumming it in a weak solution of lactic acid after it has been washed and shaved, 100 lbs. of it being given about 3 lbs. of acid and 12 to 15 gallons of water.

In this liquor the leather is drummed ten minutes, then drained and thoroughly dried. It may be stored away until it is desired to finish it, when it can be wet back with water, colored, fat-liquored and finished. The wet skins, after the acid bath, can be tacked out on boards to dry, which enables the tanner to get the greatest possible measurement. Leather treated in this manner finishes up into superior stock, soft and fully tanned.

While the skins are in the dry state, especially if they have been tacked on boards or stretched in frames and are flat and smooth, they can be sorted into grades more easily than when they are wet from the tan bath, as the condition of the grain

can be plainly seen. They can then be run in warm water in a drum, and colored and fat-liquored in the usual manner. During warm weather it is not always practicable to tan and finish skins in the regular order, and unless they are preserved in some way after they have been unhaired and bated, they will decay. By pickling them with sulphate of alumina and salt, which is really a form of alum tannage, they can be stored away in a small space for future tanning. And by treating chrome-tanned skins as directed above, they too can be packed away immediately after they are tanned, and finished at a later date, which sometimes is a convenience.

TANNING WITH GAMBIER, SUMAC AND OAK EXTRACT.

This process of tanning may be used in tanning sheepskins, calfskins and goatskins for linings and also for other black or colored leather. The skins may be pickled or tanned after drenching, without pickling. A liquor composed of gambier and sumac of about 10° barkometer is prepared in a paddle. After having been in this liquor five hours, the skins are put into a gambier liquor of about 20° barkometer. It is advisable to add 1 quart of acetic acid for every five or six dozen skins, they remaining in this liquor seven hours.

The third liquor should be made up to a strength of 30° or 35° and the same quantity of acid be added to it. For pickled skins the liquor must also contain salt. After the skins have been in this liquor half an hour, a pailful of oakwood extract is dissolved and added. When thoroughly tanned, the skins are horsed up and drained, and then sumacked. A sumac liquor is made up in a paddle by using 25 lbs. of Sicily sumac in water heated to 125° F., the liquor being cooled down to 90° F. before the skins are put in. They may be turned in this liquor several hours, or an hour or two and left in over night. They are then drained, rinsed off and hung up to dry, or fat-liquored and dried. When dry, the leather may be dampened, shaved and colored or dyed black; it finishes soft and well-tanned.

Undoubtedly equally good results would be obtained by tanning with quebracho in place of gambier.

HOW TO MAKE AND USE SULPHONATED OILS.

A sulphonated oil is an oil which has been subject to the action of sulphuric acid. The oils that can be sulphonated are castor oil, neatsfoot oil, olive oil and a few other saponifiable oils. Oils that have been treated to the process of sulphonation have come more and more into use in the manufacture of heavy and light leathers. They are especially useful in the fat-liquoring of vegetable and chrome-tanned shoe leather.

During the process of manufacture of sulphonated oil for acid fat-liquor, the acid must be added very slowly to the oil; the oil should be very thoroughly stirred while the acid is being added to it and while it is being washed out; the oil must be chilled while it is being acidified. The following instructions will enable anyone to prepare a usable sulphonated oil: Take a barrel and saw it in two parts just below the two hoops near the top. This makes a tub of convenient size. Then put a 15-gallon crock into the tub and surround it with cold water. If the water is not below 60° F., add ice to bring its temperature down, since it must be cold enough to chill the oil. Put 6 gallons of No. 2 castor oil into the crock and allow it to stand over night to become thoroughly chilled.

The next morning at eight o'clock stir very carefully and thoroughly into the oil 6 ozs. of sulphuric acid of 66° Bé. and stir for at least five minutes after the acid has been poured in. At eleven o'clock stir in 6 ozs. more of sulphuric acid, taking care to add it slowly and to stir very thoroughly. At three o'clock in the afternoon stir in another 6 ozs. of acid, and at six o'clock 6 ozs. more should be added under careful and thorough stirring. The next morning at seven o'clock add 6 ozs. of acid to the oil, and every three hours thereafter add 6 ozs. of acid until 24 ozs. of acid have the second day been stirred into the oil.

On the morning of the third day take a perfectly clean barrel and put a wooden spigot into it as near the bottom as possible. Place the barrel upon a box or a block so that it will be six or eight inches off the floor. Pour the acid-treated

oil into the barrel and fill the latter two-thirds full of lukewarm water. Add to the water and oil 30 lbs. of salt and stir for fifteen minutes. Do this every half-hour for five hours; then allow the oil to rise to the top, open the spigot and let the salt water run off until oil begins to show. Close the spigot and fill the barrel with warm water as before; then add 24 lbs. of salt and stir for fifteen minutes. Allow the oil and salt water to stand over night until the morning of the fourth day. Then draw the water off as before and fill the barrel again with water, adding 18 lbs. of salt and stirring as before. Draw the water off again and fill the barrel with warm water and put in 15 lbs. of salt. Stir thoroughly for ten or fifteen minutes and allow the oil to stand over night. The next morning draw the water off, and the oil that remains in the barrel is ready for use. In order to get a satisfactory product, the oil must be well stirred when washing out the acid; and the acid must never be put in fast enough to burn the oil.

To keep the oil, add a little water to it, about twice its own weight. Before adding the water, stir in enough concentrated ammonia to neutralize whatever acid there may be in the oil and to carry it to the alkaline side.

Neatsfoot Oil and Cod Oil may be combined and sulphonated in the following described manner: Mix 30 lbs. of neatsfoot oil and 20 lbs. of cod oil in a 20-gallon crock standing in a tub containing cold water. Add ice to the water to lower the temperature to below 65° F. Put the oil in the crock before closing down for the night, and in the morning it will be chilled.

For the 50 lbs. of oil use 88 ozs. of sulphuric acid and divide it into four equal portions. In the morning about eight o'clock pour one portion of 22 ozs. of the acid very slowly into the oil, stirring the oil while the acid is being added and for five minutes afterward. It should take about fifteen minutes to add the acid. Allow the oil to stand until five o'clock in the afternoon. Then add another portion of the acid, stirring thoroughly as in the morning. Let the oil

stand until the next morning; then add to it very slowly another portion of acid. At about five o'clock of the second day, add the last portion of acid to the oil, stirring thoroughly as before, taking fifteen minutes to add the acid. Thus the 88 ozs. of acid have been stirred into the oil. On the morning of the third day, the acid-treated oil is in condition to be washed. Use a large barrel or tub that will hold 100 gallons and put a spigot in it as close to the bottom as possible, and place the barrel or tub on a box so that it will stand some distance from the floor. Put the oil into the tub or barrel and add enough water at 100° F. to fill the tub nearly half full of water. To the water add a pailful of Glauber's salt and stir thoroughly, then add more water until the tub is nearly full. Allow this to stand until towards night of the third day, then open the spigot and let the water run off. Close the spigot and fill the tub as before with warm water and add a little less than a pailful of Glauber's salt. Allow the mixture to stand until the next day and then draw off the water the same as before. Fill the tub up again with warm water and 1¼ pailfuls of common salt. Stir the oil and the water very thoroughly and allow the mixture to stand twelve hours. Then drawing off the water and fill the tub again nearly full with warm water, and add 1½ pailfuls of common salt. Stir the oil very thoroughly and let the mixture stand until the next day. The water should then be drawn off, and the oil is ready for use.

In using neatsfoot oil and cod oil equal parts of the two oils may be employed. From 1½ to 2 ozs. of acid should be taken for every pound of oil; never more than the latter quantity. A little more than 1¾ ozs. is a safe quantity for each pound of oil. The acid should be divided into four equal portions. When the washing of the oil is completed, add cold water, about twice the weight of the oil, and enough strong ammonia to neutralize the last trace of acid on the oil.

Castor oil may be treated in the same manner as neatsfoot and cod oils. While these oils make good fat-liquor, castor oil really makes the more desirable article, and its use

is recommended to anyone who desires to make his own sulphonated oil and acid fat-liquor.

How to Use the Sulphonated Oil.—When the oil has been properly treated with acid and washed, it dissolves readily in hot water. To use it the requisite quantity is dissolved in water and the leather drummed with the solution. One hundred pounds of chrome leather may be fat-liquored with from 4 to 6 lbs. of the oil dissolved in 12 gallons of water at 125° F. The drum used for the purpose should be perfectly clean, and the leather be warmed in a hot drum before it is given the fat-liquor. The exact quantity of oil to be used must be determined by the man in charge of the work and depends upon the degree of softness desired. Drum the leather in the fat-liquor thirty minutes; then take it out and rinse it off in hot water so as to remove the oil from the surface. This washing is necessary when the leather is colored after fat-liquoring. If colored before fat-liquoring, rinse the leather, let it drain a few hours, strike it out, and hang it up to dry.

The best results, however, are secured when the sulphonated oil is combined with neatsfoot oil or some other fat-liquoring material. Used in this way it emulsifies the other oils and greases, and carries them into the leather. When neatsfoot oil or moellon degras is used with the sulphonated oil the leather becomes lubricated internally and has, when finished, the full, well nourished feel. The neatsfoot oil is heated to 160° F. Potash soap previously dissolved in a little water is stirred thoroughly into the oil. When cool the neatsfoot oil is mixed with an equal quantity of the sulphonated oil, the mixture forming an emulsion which dissolves in water. A practical formula is 6 lbs. of neatsfoot oil, 2¼ lbs. of potash soap and 6 lbs. of sulphonated oil, 3 lbs. of the mixture being used for 100 lbs. of chrome leather.

Sulphonated castor oil is also useful after glazing to preserve the finish. It is also used, either by itself or in combination with pure mineral oil, in oiling the grain of the leather before drying it out.

Vegetable-tanned skins may be nicely fat-liquored with a solution of the sulphonated oil, with a mixture of such oil and mineral oil, also with a mixture of sulphonated castor oil and neatsfoot oil, or a mixture of sulphonated oil, either castor or neatsfoot oil, and mineral oil. Of these combinations the best is undoubtedly the mixture of sulphonated castor oil and neatsfoot oil. The emulsion can be given to the leather immediately after tanning and before the skins are dried ; it can also be brushed on or mixed with the tanning liquors toward the end of the drum tannage. Bark and extract-tanned leather, after it has been split and retanned, can be fat-liquored with a mixture of fish oil emulsified with sulphonated castor or neatsfoot oil. The mixture of oils can also be added to the retanning liquor in the drum, thus giving fullness and a soft feel to the leather without additional labor.

Another important use for sulphonated oils is in the drum tanning of sole leather. "When sole leather which has already been penetrated by tannin in pits, is tanned in the drum, it is of great advantage to add to the liquor in the drum, mineral oil to which some sulphonated castor oil has been previously added. This sulphonated castor oil is soluble in water, with which it forms a more or less thick paste, and mixes in any proportion with mineral oil. The presence of the sulphonated oil enables the mineral oil to penetrate in small quantities the leather and without destroying its firmness allows it to retain a certain interior humidity, which prevents it from becoming brittle. The presence of the mineral oil and of the sulphonated castor oil has also another object, namely it facilitates the penetration of the tannin into the leather and by lubricating the inner portion of it prevents damage by rubbing of the grain against the sides of the drum. The retannage of sole leather in the drum with special extracts, perfectly decolorized, is the order of the day. Many large tanneries make use of this retannage, not only for the butt, but also for the offal. One of the most important points in this retannage is to add to the drum either at the beginning or after half an hour, some sulphonated castor oil. The oil so used prevents the

grain of the leather from cracking, which it is always liable to when the rendement is pushed too far, and on the other hand, it lightens the color of the leather. It also prevents the uncombined tannin for oxidizing during drying."

NOTES ON FAT-LIQUORING.

The following remarks relative to soap and oil used in fat-liquors are taken from an article in "Leder Industrie," a German trade paper. In the manufacture of upper leathers, fat-liquors with a soap base play an important role. A soap fat-liquor enables the leather to take up a large amount of grease without being greasy. This fact has been known for a long time, the Mexican Indians having prepared for centuries a sort of chamois leather by treating the raw skins with soap and neatsfoot oil. Napa glove leather is usually prepared with a soap fat-liquor. When the American tanners began to produce dongola and then chamois leather, they employed solutions of soap which had been useful for napa leather. Slightly tanned chrome leather, by absorbing a soap fat-liquor which contains relatively little grease, becomes very supple. Besides chrome leather, waxed calf, dyed leathers for gloves, and satin leathers are usually fat-liquored with a soap basis.

In this process the leather after tannage, is rinsed in cold water, struck out, shaved if necessary, and finally washed with water or with a weak soap solution. The extractive matters and the uncombined tanning matters are best removed with water alone. To do this the goods are placed in the drum and run for a quarter of an hour. The soap solution is now added and the leather is drummed twenty minutes longer. The soap solution is prepared by dissolving 1 lb. of good soft soap to every 100 lbs. of lightly tanned leather, shaved weight, and 1½ lbs. of soap for heavily tanned leather, in 1 gallon of hot water, and diluting with water at 100° F. to 15 gallons. The goods rapidly absorb the soap so that only clear water remains in the drum, and this operation renders unnecessary the process of brushing and stoning. The washed goods are

immediately fat-liquored. The fat-liquor is prepared in different ways, the best plan being to dissolve for each 100 lbs. of leather (drained weight) about 2 lbs. of soft soap in 1 gallon of hot water and to add to this solution, stirring vigorously, 3 lbs. of moellon free from water. A homogeneous fat emulsion is thus obtained which should be diluted with water to 15 gallons. The goods are drummed in this liquor for half an hour, when all the grease will have been absorbed. They are then quickly washed in clear water and horsed up to drain. This treatment gives suppleness to the leather, which is then set out and stuffed on the table, a grease, composed of two-fifths of degras and three-fifths of beef tallow, which fills the leather and gives weight, being used for this purpose. The skins are then dried.

The stuffing may be given at one operation, principally for leather made from heavy hides. To do this, the leather is very thoroughly washed and then fat-liquored with the following preparation: For every 100 lbs. of leather dissolve 2 lbs. of soft soap in 2 gallons of boiling water and add successively with constant stirring, 6 lbs. of beef tallow, 6 lbs. of moellon and 3 lbs. of solid vaseline or other not too thick mineral grease. The mixture is emulsified and then diluted with hot water to 15 gallons. The leather is first run in lukewarm water. The soap emulsion is then poured through the axle and the leather is drummed one hour. It is then withdrawn, horsed up to drip, hung up to dry a little, and then struck out on the table.

For low-priced leather, the moellon or the pure degras may be replaced by artificial degras, or the degras may be mixed with tallow or wool grease. For colored or black grain leather which is to be sold by measurement, an emulsion containing less grease should be used; for example, for every 100 lbs. of leather, dissolve 3 lbs. of soft soap in 2 gallons of hot water and add whilst stirring, 3 lbs. of degras or moellon and 1 lb. of oil or vaseline. This mixture is thoroughly emulsified and diluted with water to 15 gallons. The goods are washed with soap and water, then drummed half an hour with the fat-

liquor. They are then taken out, allowed to drain and finally hung up to dry. The use of the soap fat gives greater suppleness to the leather and greater substance to the flanks. A better yield of leather is also obtained and the processes of finishing are facilitated.

Soap constitutes the chief element of the emulsion but a good soap must possess certain qualities. It should be as neutral as possible; should not contain free alkali; it should give either a clear solution with water or a good emulsion. Ordinary milk furnishes a type of an ideal emulsion because the particles of grease are so finely divided that they do not coalesce; similarly eggyolk is an ideal emulsion but its price is unfortunately against its use upon any but the finest grades of light leather. Moellon if pure gives a perfect emulsion, but its price is also high. Moellon can be profitably mixed with mineral oil in the proportion of 15 to 30 per cent of the leather.

Even when mixed with mineral oil, moellon is still too expensive, and large quantities of fat-liquors are being prepared from sulphonated oils, which produce the same effect. These oils are prepared by treating oils with sulphuric acid, which are thereby converted into soaps. The better sulphonated oils are made from castor oil, which is made from the seeds of the castor oil plant. The oil is almost odorless when pure. It is thicker than most ordinary oils and congeals only at a low temperature. It mixes in all proportions with alcohol, it being peculiar in this respect, as most other oils are insoluble in alcohol. Use can be made of this fact in detecting adulteration of castor oil with other oils.

Castor oil is itself largely employed in manufacture of leather, but the use of the sulphonated product has largely increased. The sulphonated oil and also the soap of the sulphonated oil are prepared as follows: Concentrated sulphuric acid of 66° Bé. strength is added very slowly to the castor oil in the proportion of 20 to 25 per cent. of acid. The oil is kept cold as the acid is added. The mixture is allowed to rest for a day, and is first washed with saturated salt solution

and then with water. In this way the acid sulphonated oil is prepared; this is neutralized with caustic soda or ammonia and thus a neutral product, called Turkey red oil is obtained.

All the sulphonated oils possess the characteristic property of fixing themselves to the fibers of the skin, the result being a sort of fat tannage. It must not be thought that the sulphuric acid has any injurious action, because it has lost its destructive properties and its organic combination with the oil.

Instead of sulphonating oils themselves, the free fatty acids contained in the oils may be sulphonated. Oleic acid is a constituent of most of the common oils and fats, and this may be sulphonated in the same way as the original oil. Ordinary hard soaps are the sodium salts of the different fatty acids, while ordinary soft soaps are the potassium salts. These soaps are prepared by saponifying the oils or greases with caustic alkali, by which glycerine is liberated and the soap is formed. The soap could also be made by boiling the free fatty acids with caustic alkali. If instead of saponifying the ordinary oil, the latter be treated with sulphuric acid, that is, be sulphonated, and then treated with alkali a sort of sulphoonated soap is produced, which has the power of quickly penetrating leather and currying it. The free fatty acid itself may be sulphonated and then treated with alkali; and this is the best way of preparing the sulphonated soaps, although it is more usual to sulphonate the ordinary oils and then to transform them into soaps by boiling. If sulphonated oleic acid is neutralized with ammonia, a soap is obtained which gives a clear solution in water and is used in tanning leather.

Old fish oils were formerly added to the tan liquors in paddles to prevent the formation of froth. Later on, in several processes of rapid tanning, different sorts of oil were used to prevent the drawing action of the strong tan liquors on the grain, for instance, turpentine oil, rosin oil and other greases. Turpentine oil is not suitable for this purpose, because it converts the tanning matters into coloring, which darken the color of the grain. A suitable oil for this purpose must ful-

fill two conditions; it must give a good emulsion and react neutral to the tanning liquors.

For the preparation of these tanning oils, as they are called, oils which are composed to a smaller or greater extent of soap and which may be neutral or strongly alkaline, are commonly used. The best soaps from this point of view are those already described, namely the ammonia soaps of sulphonated oleic acid, to which are added mineral oils either directly or dissolved in alcohol. Tanning oils should be used only for liquors kept in motion and are especially useful for sole leather tannage to prevent the drawing of the grain. For this purpose, and also for all strong tan liquors in the drum, add a quantity of oil about 2 to 3 per cent. of the weight of the goods. Sulphonated oils in this case are too clear, but they can be profitably used with one-bath chrome liquors for if they are alkaline they mix well with the liquors.

CASTOR OIL AND POTASH SOAP AND FAT-LIQUOR.

How to Make Castor Oil Soap.—Castor oil soap is an excellent material for fat-liquor. It can be made in the tannery in the following manner: Dissolve 2 lbs. of caustic soda in 1 gallon of water. Heat 2½ gallons of castor oil to 90° F., then pour the soda solution into the warm oil and stir the mixture until it becomes thick. Cover up the tub containing the soap and let it stand over night in a warm place. The next day the soap is ready for use. It is advisable, but not absolutely necessary, to melt the soap again in a jacketed pan fitted with a stirring apparatus. By means of this apparatus a more thorough mixing of the soap is obtained.

How to Make Potash Soap.—For any purpose for which a potash soap is required it is essential to use a pure article, but this is not always obtainable. So, to be sure of having a pure product, the safest course is to make it. This is easily done, as pure caustic potash can be readily obtained. A good soap can be made, even with crude appliances, according to the following formula: Put 224 lbs. of red oil in a kettle and heat it to 100° F.; then run in slowly with constant stirring,

10½ gallons of solution of caustic potash of 60° Twad. Allow to stand twenty-four hours and the soap is ready for use.

Castor Oil Fat-liquor.—1. For chrome-tanned skins especially colored ones, castor oil soap and castor oil make an excellent fat-liquor, ½ lb. of the soap and ¼ lb. of the oil being used in 12 gallons of water for 100 lbs. of skins. The liquor is prepared in the usual way and applied at the usual temperature.

2. For vegetable-tanned skins, 10 per cent. of the soap and 5 per cent. of the oil, calculated on the weight of the dry leather, may be used, making the skins soft and well nourished. The leather should be uniformly damp and run in the liquor until the oil and soap are entirely absorbed, and then hung up and dried. Fat-liquoring can also be done immediately after the skins are tanned, washed and pressed; they are then dried, and colored later on. Or they can be dried from the tan, then fat-liquored and finished.

A PROCESS OF FAT-LIQUORING.

Leather, especially chrome-tanned leather, is treated with different fats and oils for the purpose of softening and filling it. These fats and oils are usually prepared with alkaline substances, such as soda, borax, etc., which are cooked together. But in order that the skins may retain their natural properties as little alkali as possible should be used. Soaps and soaped oils are injurious to the leather and are liable to cause spewing.

Where hard lime water is used this difficulty becomes more pronounced. In the fat-liquors which will be described there is no soap and only the smallest possible quantity of soda. The fat remains in its purest natural condition, and therefore yields the highest results and can be mixed with water without the aid of machinery. An emulsifier, however, is of course useful when a large quantity of the fat-liquor is being prepared.

With some changes these new fat-liquors may be also used upon bark, extract or alum-tanned leather, but they are especially prepared for use in connection with the chrome tan-

nage, and are applied in the following manner: The washed and shaved skins should be drummed in warm water in order to heat them. While the drum is in motion, add the first liquor, which has been diluted with water. The drum should be revolved ten minutes, when the oil will have been absorbed by the skins. It is easy to determine whether all the oil has been absorbed by noting that the liquor, which was clouded and milky, has become as clear as water.

This first liquor, which consists of an emulsion of rosin oil with a little starch, is used to render the skins fine and soft and to prevent them coming out in a condition which may be described as a "greasy dryness." Colored skins assume a brighter luster by this process. Skins that have been colored after going through the first liquor are washed in cold, then in warm water, and fresh water is next turned into the drum.

The second liquor, which has been diluted with warm water, is then poured into the drum, which is revolved for one-half hour. The fluid should then be as clear as water, all the fat having been absorbed. The choice of fat must be made according to the amount of filling, softness and luster wanted in the finished leather.

The fat-liquors are prepared as follows for 100 lbs. of leather. The first liquor which consists of rosin oil to the amount of ½ per cent. of the weight of the leather is compounded in this way: In 1 quart of soft water at 158° F. 20 grains of soda are dissolved. Add to this 30 grains of potato starch, previously kneaded into dough with ½ pint of lukewarm water. Then ½ pint of rosin oil is slowly added. The milky solution thus obtained may be diluted as desired with warm water. Should the skins have a hungry feel, a double quantity of soda and starch may be given.

The second fat-liquor is made thus: In 2 quarts of warm water 40 or 50 grains of soda are dissolved, and to this solution 60 to 72 grains of potato starch, previously kneaded into dough with lukewarm water, are added. One pint of heated rosin oil is next slowly added. Into this emulsion, which is similar to the first, the fats and oils which must first be heated, are slowly poured.

For example, to obtain a good full leather, with a fine feel and softness and of medium luster, 1 lb. of sod oil or degras or a mixture of both, 1 to 2 lbs. of neatsfoot oil and 1 lb. of vaseline oil are added. If this mixture is properly prepared no oil or fat will float on it. But should oil or fat be found floating on the surface, a little more starch and soda should be added. The process is simplified by running the solution through an emulsifier. In order to impart the Russia leather scent to the leather a little birch oil may be added to the emulsion.

These fat-liquors should never be boiled and also be guarded against cold. They must therefore be kept in a warm place, as in both boiling and chilling the oils and fats separate in drops or lumps. They should also be mixed only with warm, not boiling, water, and applied to warm skins, the latter being kept warm until finished (dry), or at least until the setting-out. The fat-liquors keep in a warm place, especially if they have passed through a good emulsifier, without being altered, for several days; one can therefore make a stock. The stock of preparatory liquor is kept best by itself, and one can take the necessary quantity from it for the finish liquor.

Good fat-liquors are also made by using castor oil in place of rosin oil.

OILING CHROME LEATHER.

The finishing of chrome leather cannot be called currying since no heavy stuffing or hard grease is used, the only grease that the leather receives being an emulsion of oil, soap and degras, or some other suitable material, and a coat of oil applied to the grain before it is dried. The oils that are used for oiling the grain of chrome leather are neatsfoot, olive, sperm, sulphonated, and paraffine. Neatsfoot oil is often used by itself, as well as mixed with paraffine oil. A good mixture for chrome glazed leather is: 1 part neatsfoot and 3 parts paraffine oils; and for dull-finished leather equal parts of the two oils. They should be warmed, mixed, and applied warm to the leather with a sponge, the leather being well struck out with a slicker before it is oiled.

Another good combination is 1 part olive oil and 3 parts paraffine oil. The mixture should be applied evenly over the grain, more being put on for a dull finish than for glazed finish. It is best not to oil the flanks. Sperm oil and olive oil are good for colored leather.

A pure petroleum oil, such as 34 gravity neutral, is suitable for any glazed leather. Good results are obtained by mixing it with what is known as fleshing oil, using equal parts of the two oils. Heat the oils to 200° F.; mix well and let the mixture cool before it is used.

To preserve the finish and prevent spewing a coat of the petroleum oil heated to 100° F. should be applied to the leather after it is finished. Finishing oils and kid oils, so-called, are nothing but 34 degrees neutral petroleum oil, although they are generally sold under fancy names at fancy prices. Fleshing oil is much cheaper than neatsfoot oil and produces equally good results.

The paraffine oils when used together with pure cod oil in proper proportions are very satisfactory for sole and rough leathers. The proportions of the two oils should be from 25 to 60 per cent. paraffine oil and from 40 to 75 per cent. cod oil. A good mixture is 40 per cent. cod oil and 60 per cent. paraffine oil. The regular 28-degree paraffine oil is the most suitable for rough and sole leathers.

Sulphonated castor oil is also used after glazing and before drying to prevent the leather cracking and oxidizing in the air. In this case it is sufficient to apply a light coat of sulphonated oil (50 per cent. water) to the grain before drying. Some workmen prefer to use for this purpose a mixture of equal parts of sulphonated castor oil and a light-colored pure mineral oil.

There are also specially treated oils procurable that have great softening properties, prevent spew and gum, and do not discolor the most delicate colored leather.

Oil of low grade and impure should not be put onto chrome leather. Such oil undergoes a process of fermentation in the leather, imparts a bad odor to it, and spews out upon the

surface in the form of white scum that is removed with difficulty. The quantity of oil applied to the grain is small and it is advisable to use only the best grade for the purpose, the increased cost being not worth considering in view of the better quality of the finish.

HOW TO TEST NEATSFOOT OIL.

Take a four-ounce vial or an oil sample bottle and fill it with oil; then place the bottle in the can of an ice-cream freezer. Prepare a mixture of 10 parts ice and one part salt, these proportions being estimated on the weight of ice used. Surround the can with this mixture. Insert a thermometer in the opening at the top, and when the air chamber surrounding the bottle has reached 20° F., keep it at that temperature for four hours. If after that period of time the oil will flow when the bottle is inverted, it is a good 20-degree oil and one very suitable for use in any way on leather. If the oil is hard and looks like lard, soften it by allowing it to stand for an hour or so at the ordinary temperature of a room and make another experiment, this time allowing the oil to cool to 25°. F. In this way the cold test of the oil can be determined. Great care must be exercised in this experiment as in all others, as accuracy is the first law of success. See to it, therefore, that the thermometer is accurate. Get a good one from any house that supplies chemical apparatus. The cold test alone, however, does not determine the quality and grade of the oil. It only helps to arrive at the final decision when the other tests are made.

The next experiment is the Maumené test. In a beaker of 100 c. c. capacity, weigh off exactly 50 grams (28.35 grams in one ounce) of oil, and add to this amount exactly 10 c. c. of chemically pure concentrated sulphuric acid of specific gravity 1.84, stirring constantly with a Centigrade thermometer. Take the temperature of the oil before any acid is added and then record the temperature after the acid has been added and the oil stirred for a few minutes. During the addition of the acid a gradual rise in temperature will be noticed, caused by heat

being generated by the change of the oil and acid into sulphonated oil. The rise in temperature should be high if the oil is a pure animal oil, and yet not too high, because the rise in temperature for a pure neatsfoot oil is 45° and 48° Centigrade. If the rise is higher or lower than the figures given adulteration may be suspected.

The mixture in the previous experiment should not be thrown away but poured into a 100 c.c. graduated cylinder and set aside for two days. If there is mineral oil present in the sample under examination, it will separate out when standing for that length of time, as sulphonated oil does not unite with mineral oil. By this method it is possible to determine the amount of mineral oil.

Also purchase with a thermometer for oils, a hydrometer which records readings from .908 to .938, and with this instrument take the specific gravity. A pure oil ought to record between .915 and .918. Anything higher or lower is indicative of an inferior product.

While these tests are not absolute proofs of the quality of the oil, yet if good judgment is used in the matter, they will be sufficient to say whether it is safe to use the oil or not. There are many houses selling oils, but few are handling the pure 20-degree oil, which is the best for use on leather. No tanner can afford any but the best grade of oil upon his stock.

LEATHER STAINING.

Where it is deemed desirable to color leather upon the grain-side only so as to leave the flesh-side uncolored, the solution of dyestuff is generally applied with brushes; and in this method of staining there are some advantages in using acid dyes instead of basic colors. The grain of leather is frequently marred by slight defects and it is desirable to conceal these as much as possible. Where acid dyes are used the defects do not show so plainly.

The best way to stain leather is to apply two or three coats of color rather than one strong one, and, of course, much care must be exercised to get the color on uniformly and to not use the solution too strong.

A dye that dissolves readily in water at the boiling point should not be boiled, but a dye that does not dissolve readily should be shaken into boiling water and then boiled and stirred until it is dissolved. The strength of the solution must be decided by the dyer, and it depends upon the kind of dye that is being used and the nature of the tannage and the condition of the leather; no inflexible rule can be followed. Some kinds of leather require more dye than others. It is usually safe, however, to start with one ounce of dyestuff to the gallon of water, and if this solution proves to be too weak to add more dye until the color is satisfactory. If the water is very hard the addition of a little acetic acid is beneficial.

The full depth of shade can be obtained with acid dyes only when some acid is added to the dye bath. Formic acid is better than sulphuric acid for the purpose since it does not cause decay of the leather. Sodium bisulphate is used in place of acid with good results. It causes slower dyeing and more uniform results than sulphuric acid.

Some dyers attain the best results by first applying an acid dye to get the foundation color and then applying a basic dye. If the leather is in the form of hides or kips two men can do the staining much better than one. The entire surface should be gone over as quickly and as evenly as possible. The second and third coats may be given from the same solution as the first if that produces the shade that is wanted; if not, some other dye may be applied. Yellow is frequently the bottom color on which shades of tan and brown are obtained.

The toning down of bright shades should be done with blue or green aniline colors rather than with chemicals, such as copperas, bichromate of potash, etc., since the latter often injure the grain of the leather. The leather should be rubbed off with a soft rag and glassed or rolled down upon the grain before it is hung up to dry.

Where the grain is rather open and porous some filling material should be added to the dye liquor to keep the color on the surface and to give the leather a better appearance.

Starch, Irish moss, gelatine, glue, mucilage, linseed jelly and other substances are used for this purpose.

The leather should be damp when it is being stained. If it is too dry the grain should be brushed over with water or a very weak solution of the dye before the stain is applied. After the leather has been given the first coat of stain it should be dried and the second coat then brushed on. A third application of stain may be necessary to get the full depth. A soft-haired brush should be used, and the solution of dye may be quite strong for the second and third applications. In most cases it is advisable to add a little methylated spirit to the stain.

Bark-tanned leather in the form of sides, kips and skins is generally dyed by means of the brush so as to leave the flesh-side uncolored. The leather, after it has been shaved, washed, stuffed with oil, and dried, is tanned with sumac, partly in vats or a paddle and partly in a drum. The temperature during this treatment, which lasts from one to two days, is gradually raised from 105° to 120° F. After this treatment the leather is given a short passage in a weak sulphuric acid bath (for bleaching purposes sugar-of-lead solutions are also applied in several consecutive baths), set out, aired and set again. When dry, the leather is ready for dyeing with the brush. It is advisable to first moisten the leather lightly with water or a clear decoction of sumac. For leather with a damaged grain a weak solution of titanium-potassium oxalate is still better adapted, because it gives the damaged portions the appearance of the sound portions of the grain. The warm dyestuff solution is then brushed on until an even shade has been produced throughout on the leather, which is indicated by the leather being evenly moistened. Finally the leather is set out on a glass table by means of a brass slicker; the grain is lightly oiled with linseed oil; and the leather dried.

The affinity of the dyestuff for leather with hard grain and inferior absorbing property may frequently be much improved by brushing on a strongly diluted solution of lactic acid previous to dyeing.

In the dyeing of very light shades, such as grey, beige, mignonette, etc., it is helpful to use some olive-oil soap, which is either applied separately previous to dyeing, or added to the dyestuff solution, 8 ozs. of this soap being sufficient for 10 gallons of the liquor to be brushed on. Acid colors are employed for this purpose but without the use of any acid.

The residue of soap is removed by rinsing the leather after it is dyed. After drying, the brushing-on may be repeated, if necessary, with other solutions, according to the shade to be produced, the leather being then glazed or embossed, dressed and dried.

When splits or leather with a severely damaged grain are being dyed some potato starch (about 1 to 2 lbs. per 10 gallons of liquor) is added to the color solution in order to insure a thorough covering of the grain. Such leather may be still further improved by dressing with repeated applications of cold gelatine solutions, which may be stained if necessary, or clear solutions of Irish moss. For this same purpose such colored caseine solutions as are fixed insolubly on the fiber of the leather by means of formaldehyde may be used; further, shellac-borax or shellac-ammonia solutions come into consideration.

Heavily-stuffed leather, so-called russet upper or harness leather, is for certain purposes produced in colors. To this end the grain side is first cleaned with a solution of borax, dried again, and stained several times over, very evenly, with a shellac and alcohol solution by means of a linen pad. It is well to give the first coating with the addition of only a small amount of shellac, for instance, 1 lb. or 1½ lbs. shellac per 10 gallons of alcohol, in order to insure a better penetration and leveling, this quantity being increased to about 4 or 5 lbs. per 10 gallons for the subsequent coatings if a bright glaze be essential. The more dilute and the more even the coating and the oftener it is repeated, the more level the dyeing will appear. The leather should be dried after each coating.

The color solution is prepared on the water bath by dissolving a dyestuff soluble in spirits in one-half of the requisite

quantity of alcohol, and the shellac in the other half, the two solutions being mixed before use.

The leather, after having been cleaned with borax, is frequently also stained first with decoctions of wood colors, with the addition of alkalies, soda or ammonia, and may then be topped with a solution of basic colors. The requisite gloss is then imparted by the application of the unstained shellac that has previously been mentioned.

For staining a deep, rich black on vegetable-tanned leather, the flesh-side remaining undyed, Leather Black TB or TG pat. is applied as follows: Use 1 lb. of the dye and 8 ozs. of acetic acid in 10 gallons of water. The solution should during its application be kept at a temperature of from 120° to 140° F. Usually two applications are sufficient for the dry leather. The grain of strongly greased leather should, however, be well brushed with a 1 to 2 per cent. borax solution to which it is of advantage to add 1 oz. of ammonia, until the grain is thoroughly wetted.

CLEARING AND COLORING SKINS AND SKIVERS.

Vegetable-tanned skins and skivers can be nicely prepared for coloring by being cleared with sulphuric acid, treated with sumac, then with fustic extract and titanium-potassium oxalate, and lastly dyed to the desired shade with acid dyestuffs and formic acid.

The clearing bath is prepared by warming water in a paddle to 85° F., and adding to it 1 pint of sulphuric acid for 100 or more skins according to their size and thickness. The skins, previously sorted and wet down, are run in this bath one hour.

The next operation is the treatment with sumac. The quantity of sumac may be about 3 lbs. for 225 average skins. The sumac is mashed with hot water, then added to lukewarm water in the paddle, and the skins are thrown in and run for one hour, and then taken out and set out. Both the clearing and the sumac baths may also be carried out in a drum in less time than in a paddle. This preparatory treatment clears

the grain and gives it a nice light color for coloring. The next process is the treatment with fustic extract and titanium salt. For 100 lbs. of leather 1½ pints of fustic extract and 4 ozs. of titanium salt are used. The fustic extract is dissolved and added to warm water and the skins are drummed with the liquor twenty minutes. Half of the titanium salt dissolved in a little hot water is then added, and five minutes later the rest, and at the end of fifteen minutes the leather may either be colored and fat-liquored, or fat-liquored first and colored afterwards. Very little fat-liquor is necessary to impart the necessary softness. Acid fat-liquor is satisfactory. When it is given to the skins before they are dyed the dye bath, which immediately follows, should be warmed to 95° F. At first the leather is run in the warm water, then the dissolved acid dyestuff is added to it in portions of one-third at a time, and after the last portion is in, the skins are drummed twenty minutes, 4 ozs. of formic acid for 100 lbs. of leather being next added, and the skins are drummed ten minutes longer or until the color is well developed; they are then rinsed, set out and dried.

It is practicable to fat-liquor and color in one bath by adding some sulphonated oil to the solution of dye and drumming the skins in the liquor.

India-tanned skins can be cleared with 1 per cent. of tartar emetic or ½ per cent. of lactic acid, retanned with sumac, washed and colored with either basic or acid colors. When lightly retanned with sumac this leather colors easily with basic dyes, used in a neutral bath at 120° F., 2 per cent. of dyestuff producing a full shade. When too much dye is used, a bronzing effect results, but this may be overcome by adding a small percentage of acetic acid to the color solution. Bark-tanned skins are nicely cleared by the use of ½ per cent. of borax and the same quantity of Wyandotte tanners' soda. For light shades such clearing should be followed by an application of sumac and then a running in a solution of sulphuric acid. It is also advisable to add from 1 to 2 per cent. of tin crystals to the sumac liquor. Acid colors are

faster to light than basic ones, and produce bright shades. Formic acid used with them has no injurious effect upon the leather and is therefore better for the purpose than sulphuric acid.

LIGHT RUSSET COLOR ON LEATHER.

A light shade of russet is secured on vegetable-tanned leather by first bleaching with borax and lactic acid, then applying a fustic liquor, and next coloring with Philadelphia yellow and Nankin yellow. This process is especially suitable for combination-tanned leather.

To prepare the bleaching liquor, put 1 bushel of rye bran into a barrel filled with warm water and let it ferment and become sour, when it is ready for use. Take three pailfuls of the bran liquor and 4 lbs. of borax for 150 lbs. of leather that has been fat-liquored and dried. Dampen the leather with warm water, and when it is soft, put it into a drum together with 10 pailfuls of water at 90° F. Add the borax dissolved in hot water to the water in the drum, and run the leather in the solution ten or fifteen minutes. Then throw in the bran liquor and drum fifteen minutes longer. The borax cleanses and saponifies whatever fat there may be in the grain of the leather, and the lactic acid opens up the grain so that clear and bright coloring is obtained. A weak solution of sulphuric acid may be used in place of the bran liquor, but it is more liable to weaken the fibers of the leather.

After the treatment with borax and bran liquor or acid, the leather should be washed very thoroughly and given the fustic liquor. Dissolve two pailfuls of extract of fustic and 2 quarts of salt in a barrel half full of boiling water; then fill the barrel with water. For the 150 lbs. of leather use 3 pailfuls of the fustic liquor and 8 ozs. of alum. Dissolve the alum in a little hot water and add the solution to the fustic liquor; then add the fustic and alum liquor to 9 pailfuls of water heated to 90° F. Drum the leather in this solution twenty minutes. Dissolve 18 ozs. of Philadelphia yellow, 13 ozs. of Nankin yellow and 6 ozs. of cream yellow. Add 9 pailfuls of water

and use the liquor at 110° F., running the leather in it twenty minutes. Use the alum to set the color. Dissolve a double handful of alum and add it to the water in which the leather is rinsed after coloring. Rinse the leather, dry and finish it. Leather that has not been fat-liquored may be cleared by drumming with a solution of alum and salt, then drummed in fustic liquor and colored as directed. After coloring, the leather is hung up and dried, then dampened, fat-liquored, dried and finished. This method of treating the leather produces a light, uniform russet color.

Dark Russet Color on Leather.—A dark russet color can be obtained by applying the following process to 150 lbs. of combination-tanned leather that has been dried out after tanning without being fat-liquored.

Dampen the leather with warm water, then put it into a drum together with 7 pailfuls of water heated to 90° F. Dissolve 3 quarts of alum and 5 quarts of salt in 3 gallons of hot water and add the solution to the water in the drum. Drum the leather fifteen minutes, then wash it and it is ready to be colored.

For the purpose of coloring it run it in a solution of 9 pailfuls of warm water to which ¾ of a pailful of logwood liquor and 3 pailfuls of fustic liquor have been added. At the end of twenty minutes stop the drum and drain the liquor out.

Dissolve in boiling water 24 ozs. of bronze No. 2 and 3 ozs. of acid orange; add the solution to 8 pailfuls of water at 110° F. Drum the leather in this solution twenty minutes; then stop the drum and drain the liquor off. In the meantime dissolve in boiling water 1 lb. of Nankin yellow Y, ½ lb. of cream yellow and 2 ozs. of Bismarck Brown B. Add 7 pailfuls of water at 110° F., and drum the leather in the liquor twenty minutes; then drain the liquor off and hang the leather up to dry before anything else is done to it. When dry the leather should be dampened with warm water and fat-liquored liberally. It is next set out on both sides and either hung up or tacked on frames to dry for finishing.

NOTES AND SUGGESTIONS ON LEATHER DYEING.

Storing and Dissolving Dyestuffs.—Dyestuffs that are used in leather coloring should be stored in a dry room where they are well protected from dust and moisture. A package, after it has been opened, should always be closed up well again to prevent the contents from becoming mixed with particles of other dyestuffs flying about in the air, and from absorbing too much moisture from the atmosphere.

The dyestuffs are dissolved to best advantage in wooden tubs or in enameled, earthenware, glass or porcelain vessels. Metal vessels are not so well suited, being apt to affect the solutions of some dyestuffs.

For dissolving dyes it is best to use either distilled water, pure condensed water or rain water. In the case of basic colors, it is necessary to correct hard, calcareous water with acetic or formic acid. Particulars regarding the quantities of acid to be used for this purpose will be found in the following table. 100 gallons of water of 10 English degrees of hardness require for softening approximately:

$9\frac{1}{4}$ ozs. acetic acid of 30%=8° Tw.
$5\frac{1}{2}$ ozs. acetic acid of 50%=12° Tw.
3.4 ozs. acetic acid of 80%=15° Tw.

or

$8\frac{1}{2}$ ozs. formic acid of 25%=12° Tw.
$4\frac{1}{4}$ ozs. formic acid of 50%=24° Tw.
$2\frac{1}{2}$ ozs. formic acid of 80%=37° Tw.

Basic colors are dissolved by stirring them into boiling water, to which the requisite quantity of acid may be added; in the case of larger quantities, the dye solutions are passed through a filter or hair sieve. Dyestuffs which are not readily soluble are mixed to a paste with some acetic acid, hot water being afterwards poured over the paste.

The diamond phosphine dyes behave more favorably than the other basic colors, and by reason of their indiffereuce to lime in the water may be dyed without the addition of acetic acid.

Acid colors are dissolved without any acid, and the same is true of chrome leather colors and the anthracene and diamine colors. The solubility of some of the anthracene colors is improved by mixing the dyestuff first with one-half its weight of ammonia and then pouring hot water over the paste.

Immedial colors are stirred into a boiling sodium sulphide solution, an equal quantity of sodium sulphide as of dyestuff, or half as much again, being in this case required.

It is not generally advisable to keep large quantities of dyestuff solutions in stock, since by standing for some length of time, the concentration is apt to change through the precipitation of a portion of the dyestuff, and exact working is thus rendered more difficult.

If fastness to rubbing and good penetration have to be considered, the acid colors are in every case to be given the preference. Special attention has to be paid to good neutralization before dyeing, if good penetration be required, because any acid remaining will fix the dyestuff entirely on the surface of the leather. The requisite acid is therefore not added until the dyeing is nearly completed, or after the leather has been drummed with the color twenty minutes.

The various groups of dyestuffs should as far as possible be dissolved and applied separately. Basic colors have necessarily to be dissolved and applied by themselves. Acid colors may be dissolved and applied either alone or in combination with diamine and anthracene colors, as the case may demand; they are also applied frequently for bottoming or topping other dyestuffs, as for instance, basic colors.

Acid colors are usually applied with the addition of some acid, 4 parts by weight of an acid color usually requiring 1 part by weight of concentrated sulphuric acid, or 2 parts by weight of 50 per cent. formic acid, which before use should be very strongly diluted with water, for instance, with one hundred times it weight. The acid is added in order to prevent precipitation of the dyestuff; it is not added to the stock solution, but to the dye bath when already charged with the dyestuff and other ingredients, usually to the best advantage

when the leather has taken up the color. The use of formic acid is to be given the preference over sulphuric acid, because any excess of it evaporates, while sulphuric acid remains permanently in the leather. Basic colors, apart from the acid that is added to correct the water, require as a rule no further addition. It is an advantage, however, in the case of some of the basic colors which have a tendency to bronze in concentrated solution, to add some acetic acid.

To Soften Hard Water.—Water that is made hard by carbonate of lime may be softened by the use of quicklime, sal soda or ammonia. When there is time to allow the water to settle, lime is the best material to use. To soften with lime have the water in a large tank or hogshead. Pour enough water on the quicklime to slake it. When it falls to powder add enough water to make a thin cream and then stir this into the water to be softened. Use 1 oz. of lime for every 40 gallons of water. Do not let any undissolved lime go into the water. Allow the water to stand twelve hours. The carbon dioxide, which held the carbonate of lime in solution, will be absorbed by the lime and the liberated carbonate of lime, falling to the bottom, leaves the water soft.

How to Color Chrome Leather after Fat-liquoring and Drying. The skins, fat-liquored and dried without coloring, are thoroughly soaked back in warm water, and are then ready for dyeing. The process is best carried out in a drum fitted with steam pipes to keep the dye bath hot, the temperature of which should be 140° F.

The manipulation is as follows: The dye is carefully weighed out into a small wooden tub and dissolved by pouring upon it 200 times its weight of boiling water, stirring briskly all the time until the dye is dissolved. Bisulphate of soda, equal in weight to the weight of the dyestuff, is dissolved in a sufficient quantity of hot water in a separate vessel. Half of the concentrated dye solution is now added, together with the bisulphate of soda solution, to a sufficient quantity of water at 140° F. in the drum to cover the skins; the goods are entered and the drum is started. After the goods have been running in

this dye bath fifteen minutes, the remainder of the dye solution is added, and the drumming continued for at least thirty minutes longer. The quantities of dyestuff and of bisulphate of soda necessary for each dozen skins is 8 to 10 ozs. of the former, according to the desired depth of shade, and, as stated an equal quantity of the latter. After dyeing, the skins are washed in warm water, set out, lightly rubbed over the grain with glycerine and dried out and strained on boards.

To Dye Colored Leather Black.—1. By carrying out the instructions which follow, colored chrome-tanned calfskins, goatskins, sheepskins and side leather can be dyed black and finished into black leather.

Put 125 calfskins or 250 goatskins into a drum together with warm water and run them until they are thoroughly soaked and then drain the water off. Next take 5 lbs. of Wyandotte Tanner's Soda and 100 gallons of water and drum the leather one-half hour in this, after which add 1 quart of ammonia, and drum another half-hour. If a paddle wheel is used instead of a drum, take the same number of skins and the same proportions of soda to each 500 gallons of water in the paddle; run an hour, and then add 1 quart of ammonia, and run another hour. It is advisable to allow the skins to remain in the solution over night. By using this process it will be found that the dye will penetrate well and give a very deep black. It will also be impossible to detect the fact that the leather had previously been colored fancy shades. Any suitable chrome blacking process may be used on skins prepared a directed, direct acid blacks being especially suitable after the leather has been thoroughly washed.

2. The following process is said to be a good method of redyeing leather that has been colored unsatisfactorily: Put the leather into a drum and run it with warm water for at least one-half hour to remove the finish and to prepare the goods to receive the dye. Now, for each dozen skins of medium size or for eight small sides, dissolve from 4 to 8 ozs. of permanganate of potash crystals in 6 gallons of warm water and drum the leather in the solution fifteen minutes. Dis-

solve from 12 ozs. to 1 lb. of logwood crystal in 10 gallons of hot water and add this liquor to the potash solution and skins in the drum, and run the drum one-half hour. Next dissolve 1 oz. of copperas and blue vitriol and cool the solution; add it to the contents of the drum and drum ten minutes. Finally wash the leather in clear running water for at least fifteen minutes. The leather is now ready to be set out and dried. The skins must always be thoroughly washed and the grain should be liberally oiled with a mixture of paraffine and cod or neatsfoot oil before they are dried out.

Coloring Process for Chrome Leather.—Chrome-tanned skins of any description can be nicely colored by first mordanting them with extract of sumac and acid dye, and then dyeing to the shade desired with basic colors. The skins are neutralized, washed, shaved and weighed, the quantities of dyeing materials mentioned being for 100 lbs. of leather. Use 2 lbs. of sumac extract and 6 ozs. of acid brown dye for the bottom. Dissolve the sumac in hot water; dissolve the dye, add it to the sumac, and strain the liquor, of which there should be 10 gallons at 110° F. when it is given to the skins. Drum the leather with this solution thirty minutes; then add 2 ozs. of titanium-potassium oxalate dissolved in a little hot water, and run the drum twenty minutes longer. Wash the skins in two changes of warm water, and they will then be ready to receive the dye. Any shade of tan and brown can be obtained upon skins mordanted in this manner, red brown shades being best secured by the application of basic colors. After the leather has been drummed with the dyestuff one-half hour, drain off the exhausted liquor and give the goods the fat-liquor.

Titanium Mordants for Chrome and Vegetable-tanned Leathers.—Extremely fast and stable colors that are fast to light, washing, soaping, rubbing, etc., are obtained by treating leather previous to coloring with a solution of the salt of titanium known by the trade name of titanium-potassium oxalate.

In comparison with other mordants the quantity of titanium salt required by a given lot of leather is very small indeed;

no addition of acid is required, and after the titanium oxide has combined with the leather, the very small amount of oxalic acid freed from the double salt is mainly in the bath, and the rest is easily washed out if necessary.

The solutions are applied in the drum, paddle, tray or by brushing on. Acid dyes may be used in the same bath. Retanning with sumac, quebracho, gambier, bark extract, etc., may be done in the same bath with the titanium mordant. The mordant goes on very evenly and rapidly, ten minutes in the drum being ample time. If the mordant bath has not been exhausted, which soldom is the case, the leather should be washed before basic colors are applied. Usually the mordant is all taken up by the leather, and in such case, after running off the liquor, basic colors, run in without washing, the leather give most excellent results.

When titanium salt is applied to vegetable-tanned leather, or to chrome leather lightly treated with some tannin, or to a combination chrome leather, the titanium unites with the tannin of the leather to form a yellowish-brown titanium tannate, which combines with the fiber of the leather and which is fast and stable and brings up subsequent colors in a remarkable way. All shades of yellow, tan, brown, green, maroon, red and dark blue are thus ready for dyeing to shade.

One-half per cent. of the weight of the leather is sufficient to give a yellow mordant base on which both acid and basic colors dye freely, evenly, and rapidly. The shade of yellow-brown produced varies with the kind of tannin in the leather, sumac usually giving the more yellowish shade. Young fustic with titanium gives a light tan. Gambier and fustic, red shade, with titanium give the browner shades of tan. Some practical methods of dyeing with titanium on both chrome and vegetable-tanned leather follow.

1. For 100 lbs. of dry vegetable-tanned skins. Drum with solution of 8 ozs. of the titanium salt in warm water for ten minutes, which gives the yellow-brown base. Run in acid dye solution to bring to shade wanted ; wash and fat-liquor if not previous fat-liquored. For deep colors, some dyers put

on the dyes first and then run in the warm solution of the titanium salt. It is said that this method seems in some cases to brighten up the color better than to mordant first. Acid dyes and alizarines may be used in the same bath with the mordant. When using basic dyes it is best to drain the drum between the two applications.

2. For 100 lbs. of wet chrome skins. Neutralize the goods with borax or soda and wash well. Drum them with sumac or gambier to give the tannin bottom. Run in solution of 4 ozs. of the titanium salt and drum ten minutes. Then run in the usual acid dye to shade, or wash and run in basic dye. Wash and fat-liquor.

3. *Black with Logwood on Chrome-tanned Skins.*—For 100 lbs. wet weight of skins, neutralized and washed. Prepare the dye bath with 1½ lbs. of logwood crystals or 3 lbs. of logwood paste. Prepare another bath with 4 ozs. of titanium-potassium oxalate in hot water. Drum the skins with half of the titanium solution for ten minutes. Next run into the drum the hot logwood solution and drum fifteen minutes and drain the liquor off. Run in the other half of titanium solution and drum ten minutes longer. Drain the liquor out of the drum and run in the fat-liquor. If specially deep penetration is wanted on one-bath chrome skins, it is best to use logwood of lowest oxidation. Generally 6 lbs. of logwood crystals are used to 1 lb. of titanium salt.

4. *Black on Vegetable-tanned Skins.*—After the logwood, slightly alkaline, is on the leather, run into the drum 8 ozs. of titanium salt in warm solution and drum ten minutes. Wash, fat-liquor and finish as usual. If the black is required to run deeper or through the leather, it is advisable to drum the skins first with half the amount of titanium salt, then with the logwood liquor and top with the rest of the titanium salt. Logwood blacks on chrome-tanned skins are quickly produced and are of a permanent and durable character when titanium salt is used as a striker.

5. For 250 lbs. of dry vegetable-tanned skins, lightly retanned with sumac, a blue-black flesh and black grain are

obtained by using methyl violet aniline and aniline, or direct leather black. First drum with 8 ozs. of methyl violet aniline; then fat-liquor in the drum. Next run in a solution of aniline black with green cast, 4 to 6 ozs., and a solution of 4 ozs. of titanium salt and drum about fifteen minutes. Drain, rinse, dry and finish.

Chrome-tanned skins, if lightly retanned with sumac or gambier, and then treated as above, give beautiful black grains and blue-black backs. 1 lb. of titanium-potassium oxalate dissolved in a barrelful of seasoning liquor is of much advantage to the finished product. One of the most important advantages in using titanium salt is in its entire elimination of the brittleness of leather caused by the loss and regain of the oxygen of the iron and copper salts frequently used in coloring and finishing grain leathers.

Formic Acid in Leather Dyeing.—In the process of dyeing leather with acid dyestuffs, it has long been customary to use sulphuric acid to get the shade. The acid so used remains in in the leather and brings about gradual deterioration of quality. Sulphuric acid may to great advantage be replaced by formic acid which, after dyeing, is entirely removed from the leather by evaporation and hence is harmless after it has served its purpose in the dyeing operation. A certain amount of acid will bring out the maximum depth of shade; but in using formic acid no harm is done to the leather if an excess of it is used, as it evaporates during the drying of the leather. With the use of sulphuric acid the maximum quantity of it required to bring out the full depth of color cannot be employed, as it cannot be washed away after coloring, and since it does not evaporate, it remains in the leather and reduces its strength. It is necessary to use just twice as much formic acid as sulphuric acid, otherwise the two processes are identical, 2 parts of 85 per cent. formic acid being required for every 4 parts of dyestuff used. The acid should be strongly diluted with water before it is poured into the revolving drum.

Lactic Acid in Coloring Leather.—Leather that has a greasy grain should be opened and cleared before any dye is applied.

Dissolve 1 gallon of lactic acid in 40 gallons of warm water and drum the skins in this solution thirty minutes. When basic colors are to be used, it is necessary to wash the leather in warm water after this treatment, but if acid dyes are to be applied washing is not necessary. This operation clears the grain of greasy matter and opens up the pores so that the dyestuff applied immediately afterwards goes on evenly and deeply.

Acetic Acid Bath for Use After Dyeing.—It is not infrequently beneficial to colored leather to pass it after it has been dyed and fat-liquored, through a bath of acetic acid 10 gallons of warm water being used for 100 lbs. of leather, and to it 3 ozs. of acetic acid are added, a new bath being prepared for each pack of skins. After having been colored and fat-liquored, the leather is taken from the drum and passed through the acid bath in a tub, and then horsed up smooth, grain to grain, and allowed to press over night. The next day it is set out by hand on the grain with a brass or rubber slicker and hung up to dry. The acid bath clears the grain somewhat and brightens up the color. No doubt formic acid could be used with equally good results.

To Prevent the Fading of Colored Leather.—1. A dressing made of casein and ammonia is said to be effective in preventing the fading of colored leather. Boil 1 pint of water. As soon as it begins to boil add ½ pint of strong ammonia to it and then dissolve 2 ozs. of casein in it. Stir the mixture until solution is complete and then add water to make 6 quarts of dressing. The dressing may at once be applied evenly and lightly to the leather after coloring, while the latter is still moist, until it penetrates. If the leather is dry the dressing must be laid on still more lightly. This solution of casein can also be applied to made-up articles. The leather should be clean before the dressing is applied, and then dried in a warm room and rubbed with a soft woolen cloth.

2. A dressing of borax and shellac is said to preserve the color of furniture leather and other leather from fading. It is made as follows: Boil 1 oz. of borax in 3 quarts of water

and add, while the latter is boiling, 1½ ozs. of shellac and just enough aniline dye of the color of the leather to match the shade. When the mixture has cooled it is ready for use. It should be applied to the leather with a soft sponge, slowly, and with care, to avoid streaks. Care must be taken, too, in selecting the shade to correspond with the color of the leather. After the dressing has been applied the leather is hung up to dry. When dry, it should be rubbed lightly with a soft woolen cloth or brushed over a felt wheel. This dressing does not affect the character of the leather, but the correct proportions of ingredients must be used, otherwise if it is made stronger, the mixture is apt to make the grain brittle. The leather should be well brushed, and, if dirty, washed with warm water and dried before the dressing is applied.

Dressing for Leather Goods and Furniture.—A dressing for goods made of leather and for leather furniture is made as follows: Put into a bowl 1 gill of hot water, ½ oz. of annotto and ½ oz. of white soap, shaved fine. Place the bowl in a pan of boiling water. Into another bowl put ½ oz. of beeswax, shaved fine, and put it in the pan of boiling water. Stir the contents of both bowls until they are melted, then take them from the fire. Into the melted wax stir 1 gill of turpentine, 1 gill of paraffine oil, and then the mixture of annotto, soap and water. Beat the mixture until it is cold; then put it in a fruit jar for future use. This preparation may be used on brown or red leather. First wash the leather with a soft cloth or sponge and hot milk, then rub the dressing on with a soft cloth. If the leather be faded, the dressing may be made darker by using two or three times the quantity of annotto. For dark green or black leather a little logwood should be added to the dressing.

How to Remove Spots and Stains from Leather. — Colored leather that is simply soiled or dirty, and not stained, may be washed off with warm castile or ivory soap suds, then dried and rubbed. Or a little acid may be added. The acid must be very mild and applied very carefully. A dirty water stain is sometimes taken out with the juice of a lemon, which is the

mildest acid that can be used. Vinegar also is employed for water and other stains.

An oil spot may be removed by dipping a piece of rubber in naphtha and rubbing over the spot. Another way is to cover the spot with cement such as is used in shoe factories. After the cement has dried for an hour or a little longer, rub or roll it off with the finger. If a little is left, go over it with the rubber dipped in naphtha. For dirt from the hands a little oxalic acid well diluted may be used. Wash the dirt off and then wash with soap and water, and perhaps apply a little of the finish. An aniline stain cannot very well be taken out, but it can be helped somewhat with a rubber. Some of the aniline can be washed off with a regular wash, as with soap and water. However, the stained part of the leather cannot be made to look like the rest because it has soaked through more or less. It depends much upon the leather as to how far aniline will penetrate. There are various preparations purchasable that shoe manufacturers use for stains, and some of these are employed to clean and polish vamps in one or more operations. Leather that becomes stained or discolored should be redyed into black stock.

Grease spots that sometimes get onto the leather from oil from pulleys or shafting may be taken out with shoemaker's cement and chalk. Put the cement on first, then lay the chalk on and work both into the leather with the flat of a knife or by any other means. The cement will eat into the grease, and it should stay on until the grease comes out, even if it takes twenty-four hours or longer. Use pure rubber cement for this purpose, for a cheap article is apt to stain the leather. The cement will dry after a little time so that it can be rolled off.

Another method is to place a piece of cloth or some cotton waste saturated with naphtha over the spot. This is covered with another cloth to prevent too rapid evaporation. More than one application may be necessary, for the grease or stain must dry out gradually. It is the naptha in the cement that is supposed to remove the grease; and it might be applied in

any other form, provided not enough is used to bleach the leather. Slight spots may be rubbed out dry with a saturated cloth. Ether is also sometimes used.

White ooze leather, and possibly also white grain leather, that has become soiled, may be cleaned with salt of sorrel. Cold water is applied to the leather, washing it all over. A mixture of salt and lemon juice or salt of sorrel, so-called, which can be secured at any drug store, is then rubbed over the soiled portion, with the result that all the spots, stains and dirt marks disappear and the leather is once more white. The leather should always be washed over with water, which must be rubbed over the entire skin; but the mixture of salt and lemon juice is applied only to the soiled portion.

THE USE OF ACIDS IN DELIMING AND PICKLING.

Lactic Acid Drench for Sheepskins.—For a lot of 800 to 1000 average limed sheepskins, 20 lbs. of lactic acid and 20 lbs. of salt are used. The water in the paddle should be warmed to 85° F.; if it is cooler than this, more salt is required to keep down the plumpness. Half of the acid and all of the salt should be added to the water before the skins are put, in and the rest of the acid after they have been in fifteen minutes. The time required for drenching should be about forty-five minutes in a paddle; in a still vat or tub, two or three hours, the skins being stirred two or three times during that time. Several packs of skins may be put through this drench, with a fresh addition of 15 lbs. of lactic acid for each succeeding pack, adding 5 lbs. at first and 10 lbs. after the skins have been in fifteen minutes. When drenched the skins should be rinsed in warm water and pickled.

The skins can also be nicely drenched by using 1 pint of lactic acid for 100 lbs. of skins. And by thorough washing before drenching the quantity of acid can be reduced to 1½ pints for 200 lbs. of skins.

Lactic Acid Drench for Goatskins.—After the skins have been bated, prepare a bath in a paddle with warm water and for 100 lbs. of skins add ½ lb. of lactic acid and an equal quantity

of salt. The water should be at 90° F. before the skins are put in; they are paddled twenty minutes, then rinsed and pickled. This method is advantageous for goods that are intended to be colored as the acid cleanses them thoroughly. The process can also be carried out in a drum, in which case only a few minutes are required to remove the last trace of lime from the skins.

Formic Acid and Lactic Acid Drench.—A mixture of 4 parts formic acid and 1 part lactic acid is efficient in drenching skins. Less than ½ pint of the mixture is sufficient for 100 washed skins. The goods are paddled thirty minutes or longer, in the drench at a temperature of 90° F. rinsed and pickled. This drench may also be used after a regular bate. Drenched with formic acid, skins tan into clear grained and uniformly colored leather.

Deliming and Pickling Skins with Formic Acid.—M. C. Lamb of the Leathersellers' Technical College, London, describes a method of deliming and pickling with formic acid which he has used successfully in practice. "The goods, after washing free from surplus lime in the paddle water at 85° F. for thirty minutes, are ready for deliming. The deliming is best done in the paddle wheel; the goods are placed in a vessel together with a sufficiency of water at 90° F.; paddling is commenced, and then the following solution previously prepared is added: 2 lbs. of formic acid (40 per cent.); 5 lbs. of common salt, for each 100 lbs. of limed skins.

"The goods are paddled until flaccid and fallen, which will generally require about thirty minutes, when they are removed and are ready for pickling. Pickling is best carried out in a drum, but it may also be done in a paddle. The proportions of acid and salt to be recommended are: 10 lbs. of formic acid; 20 lbs. of salt; 20 gallons of water for 100 lbs. of skins.

"Having been drummed or paddled in this pickling solution for one hour, the goods are removed, allowed to drain, and may then be immediately transferred to the tanning paddle or drum. Skins treated in this way require, as in the case of those pickled wiih sulphuric acid, to be tanned in salted

liquors. Basils are best tanned in the drum, using for each 100 lbs. of them an addition of 5 lbs. of common salt.

"Goods that have been treated in this way tan a beautiful light color and the tan liquor quickly strikes through; stout basils can be completely leathered in eight to ten hours, though a slightly longer period is to be recommended when weight is a consideration. Any tanning material may of course be used for the purpose; quebracho extract, particularly the sulphited quebracho extract, is, however, especially suitable, either used alone or in conjunction with chestnut extract. It will be noted that this method dispenses with the objectionable puer, and the goods require no further drenching. In the case of greasy sheepskins, the goods are generally sufficiently tanned to allow of them being removed from the drum or paddle for hydraulic pressing at the end of two or three hours' tanning. Further, when this method is employed, there is practically no liability of the skins becoming cased or crusted on the grain by the use of too strong liquors in the early stages of tanning."

Bating with Sal-ammoniac and Pickling with Formic Acid.—The following method of deliming skins of any kind with sal-ammoniac and salt and then pickling them with formic acid has been successfully used by tanners: In 700 gallons of water put 50 dozen skins, averaging thirty-five pounds per dozen; bring the water to 95° F., dissolve in it 20 lbs. of sal-ammoniac and 70 lbs. of salt, agitate the skins in the solution for two hours, and leave them in over night until they float on the surface. The combination of sal-ammoniac and salt produces ammonia and acts on the skins in exactly the same manner as the puer or manure bate, with this advantage: the tanner can control this process while he cannot always control the puer.

The drenching and pickling are effected with formic acid. The next morning transfer the skins to a paddle wheel containing in water at 85° F., 10 lbs. of formic acid and 80 lbs. of salt. After an hour's treatment in this bath proceed with the tanning process. The formic acid completely removes the

lime and strengthens the fibers of the skins, so that they will stand the corrosive action of the chemicals used in chrome tanning.

Deliming with Butyric Acid.—Butyric acid is useful for the purpose of deliming hides for firm hard leather. It accomplishes the deliming by directly neutralizing the lime; it also has a swelling action on the hides, so that the goods delimed with it present a swollen condition, which is conducive to the production of firm leather. It is advisable to suspend the hides first in the deliming liquor and then to complete the process in a drum; this causes the deliming to take place slowly at first and thus the fibers are not worked too much. The quantity of acid required ranges from 8 to 10 ozs. for 100 lbs. of skins to twice that quantity, depending upon the amount of lime according to the weight and condition of the hides.

Drenching with Boracic Acid.—Among the various chemical deliming agents and bates that may be used in preparing hides and skins for tanning, boracic acid is one of the most efficient for that purpose. The hides or skins are bated in the usual manner and are then immersed in the drench of boracic acid, which removes the last trace of lime and makes the grain soft and clean. When the acid is used alone for the purpose of deliming, it makes the grain soft and silky, hastens the tannage, and prevents the grain from becoming contracted in the tan liquor. Light skins for chrome and vegetable tanning are sometimes given a drenching with boracic acid after they have been bated, a paddle being used for the operation. When soft, silky leather is wanted, it is advisable to first use a commercial bacterial bate, such as oropon and then to drench with boracic acid, and pickle with formic acid and salt. Excellent results as regards grain, texture and color are assured when skins are treated in this manner.

Deliming and Bating with Ammonium Butyrate.—One of the more recent chemical products for deliming and bating is the ammonium salt of butyric acid, called ammonium butyrate. It is made by neutralizing butyric acid with ammonia.

Butyric acid is mainly useful when a firm, hard leather is required, while the ammonium butyrate is more adapted for producing a soft, pliable product. Ammonium butyrate accomplishes the deliming indirectly. The free lime in the goods acts on the ammonium butyrate and liberates ammonia, which, being volatile, escapes. The butyrate has no swelling action but rather the reverse, being in this respect similar to ammonium chloride, which, as is well known, has a depleting action on skins. Ammonium butyrate is therefore recommended for deliming hides and skins which are intended to enter the tanning liquors in a fallen or neutral condition, and butyric acid for those hides and skins which should enter the tan liquors in a slightly swollen or acid condition. Pelt delimed with ammonium butyrate becomes white, falls, and feels soft to the touch. There is no danger if an excess is used.

The manufacturers of this new product recommend that for box calf and for heavy chrome leathers, it should be used alone, but for chrome goat, or for sheep and goat for glove leather, in conjunction with an artificial or a natural bate.

The following are some of the methods of using ammonium butyrate: For box calf, fill the paddle with warm water and place the skins therein after weighing them. For each 100 lbs. of skins add 1 to 1½ lbs. of the material and paddle the goods for half an hour. Then allow them to rest for an hour or two and paddle again for half an hour. The skins should be now free from lime (test with phenolphthalin on a cut edge) and after rinsing are ready for tanning.

Goatskins require more pulling down than other skins so that the treatment should be more vigorous as well as longer. If ammonium butyrate is to be used alone it is recommended to take 2 lbs. for 100 lbs. of pelt. The process should be carried out in a paddle at a temperature of 90° F. The skins are paddled for a quarter of an hour each hour for four hours. If an ordinary bate is also to be given it should follow the above treatment.

For heavy chrome butts the operation takes much longer,

at least six hours being necessary. From 1 to 2 lbs. per 100 lbs. of pelt is a convenient quantity.

For chrome sheep, two or three hours is sufficient at 90° F., giving 1 lb. or more per 100 lbs. of skins.

Test to Determine the Extent of Deliming.—A simple test to ascertain how far deliming has gone by any method of deliming consists of touching a cut edge of a heavy skin or hide with phenolphthalein solution. When lime is present a violet coloration is produced, but when the skin is delimed there is no such coloration. When the deliming is complete the skins are rinsed in warm water, and then either pickled or tanned.

Deliming Horsehides, Coltskins, Cowhides, etc.—Use 1 lb. of lactic acid and 1 lb. of salt for 100 lbs. of hides for the first pack, adding the acid in two portions. For succeeding packs add ¾ lb. of lactic acid and ½ lb. of salt for 100 lbs. of hides. This drench may be used for a week or so, but the addition of salt should cease after five or six packs have been put in. The temperature of the drench should be 85° F.; the time consumed from one-half hour to four hours, depending on the weight of the hides and the agitation they receive. The more thoroughly they are washed after liming the less acid they require. After the process is completed, the hides should be rinsed in warm water and then pickled or tanned.

Heavy Upper Leather and Patent Leather.—For heavy upper leather made from hides, such as wax grain, buffed, mat or boarded leathers and for patent leather, and when thickness and weight of splits are the main considerations, the simplest method of deliming is the best. An excess of acid is used. This removes the lime and holds the hides plump.

The formula for such cases is 1 lb. of lactic acid for every 100 lbs. of hides, green weight. Bating is done in a paddle or still vat for four or five hours or over night. This bate may be used continuously for a week in warm weather, or from two to three weeks in cold weather, with a fresh addition of ¾ lb. of acid to each 100 lbs. of hides to each new pack put in. By this method good grain and fine heavy leather are obtained.

In those cases where an extra fine grain is desired, as for glove, grain and calf leathers, a more depleting bate must be employed. In starting such a bate an addition of common salt is usually made in the proportion of 1 per cent. on the hide weight, and then the lactic acid is added in several portions. The total amount of acid required is about 12 ozs. for 100 lbs. of hides. As an example: For a pack of hides weighing 2000 lbs., the amount of lactic acid to use is 15 lbs. The bate is made up by putting in first 20 lbs. of salt and 5 lbs. of acid, and the hides are then introduced. At the end of an hour an addition of 5 lbs. of acid should be made and at the end of another hour 5 lbs. more. This bate may be used a week or more until it is foul, adding the lactic acid in proportions of 5 lbs. each time for each new pack; four or five hours usually suffice for bating. No fresh quantity of salt needs to be put in, as the lactate of lime which accumulates in the bate answers the same purpose. Instead of running away all of the bate liquor after it has been used a week or so, it is generally advisable to use part of the old bate for starting a new one by running it into another bating vat and filling it up with water. The bottom half of the old bate may be allowed to run into the sewer as it will contain too much accumulated matter.

In cold weather, the bating liquor for heavy upper leather should be warmed somewhat, 80° F. being a suitable temperature. Hides should be bated four or five hours, or over night, at from 60° to 90° F., and skins one to three hours at from 75° to 95° F.

Sufficient lactic acid must be used to neutralize and remove all the lime, and enough time must be allowed for this reaction to take place. A slight excess of acid and cold water is used when a plumping effect is desired; and when a depleting effect is wanted less lactic acid is employed in warmer water and old lactic acid bate, or a certain proportion of common salt is added. Generally speaking, for skins and green split cowhides, which are to be chrome-tanned, the depleting effect is more desirable, and for heavy hides, which

are to be bark-tanned, the plumping effect. It is generally better, especially for hides, not to keep them continually agitated, but only sufficiently so to give the liquor proper circulation and free access to all the stock. The lactic acid bate gives heavy splits and firm fine-grained leather. Lactic acid in tanning liquors gently plumps the stock. In the retanning of splits it quickens the penetration of the liquor and thus shortens the time for retanning. By reason of its diffusibility, it acts uniformly throughout the hides, causing whatever swelling it may effect to be evenly distributed, thus preventing wrinkles and pipey grain.

When leather with a soft grain and elastic fiber is desired, the hides are benefited by being treated with a light borax solution after they have been bated. This is done by drumming the goods with warm water containing a small percentage of borax. Hides treated in this manner absorb the tanning material very rapidly, also produce light-colored leather, and take a very even color in finishing.

Skins that are designed for soft leather are benefited by being drummed with a lukewarm solution of naphtha, 10 lbs. of naphtha being used in 25 gallons of water. This warm bath softens the hides and loosens the hide substance, while the naphtha dissolves the grease and cleans and opens the grain, making further work unnecessary. Much hide substance is lost with this process, but the hides absorb the tanning liquors very rapidly and become soft, pliable and yet firm, also in finishing they take any color very easily.

Tanners well know that hide substance is frequently lost in bates when a natural bacterial bate is used. When soft leather is being made this loss of substance is not as important as in the case of heavy, firm leather. In the latter case, loss of substance is a direct loss to the tanner since it effects the weight and quality of his leather. A bate that does not deplete the hides too much, that is uniform in strength and clean to handle is the only bate that is suitable for most kinds of leather.

Plumpness and weight are two essentials in side leather

and splits. They are obtained largely by bating and drenching with a mild acid and by using such acids in the tan liquors. For instance, when hides or skins are being tanned in a paddle, 1 lb. of formic acid used for every 100 gallons of liquor hastens the tanning and helps to get more uniform tannage and plumper leather. Then when hides are split and retanned, lactic or formic acid added to the liquor gives plumper leather and more weight.

Calfskins and kangaroo skins that are to be tanned in a two-bath process can be delimed by being paddled twenty minutes in a solution of boric (boracic) acid, and then passed into the first chrome liquor, from 4 to 8 ozs. of the acid being the quantity required for 100 lbs. of skins.

THE TANNING OF SEALSKINS.

Raw sealskins come to the tanner in a freshly salted condition, and are, broadly speaking, divided into two classes: "small" or "white-coat seal" and "large" or "cow seal."

The "small" or "white-coat" seals are principally used for making levant grain leather, and "large" or "cow seals" for walrus grain, though a grain similar to the latter is frequently produced on the small seal and likewise the levant grain on cow seals. As the processes differ somewhat, in order to obtain these different grains, it is necessary to describe them separately. Before doing so it is well to say a word concerning the water to be used and the effect it has upon the leather. A very soft water produces poor, soft, hungry leather, the grain being soft and of poor formation, while a very hard water makes solid, tight leather, and the grain is flat and difficult to work up. Experience has taught that a moderately hard water produces the best results and is most suitable for tanning seal skins.

Levant Grain.—The skins, when received by the tanner, are covered with salt and very greasy. A convenient pack of about twenty-five dozen is placed in the soak pits. The water in the pits should not be absolutely cold, and during the winter it is necessary to warm it a few degrees.

After remaining in soak for a day, the pack is hauled up and fleshed over a beam. As much as possible of the loose blubber and grease is removed by the beamsman. The skins are then put into a fresh soak and remain in it forty-eight hours, when they are again scraped over the beam, this time on both flesh and hair sides. It will be found that, owing to the very greasy nature of seals, that the beamsmen have difficulty in handling their knives, but this is readily overcome by occasionally rubbing their hands with sawdust.

The skins are now ready for liming. White lime alone should be used, as it has been found to produce the best results. Sodium sulphide in conjunction with lime produces "pipey" grain, but arsenic and lime a soft and silky grain.

For the ordinary pit, a half barrelful of lime is slaked in the usual manner, and when filled with water, is thoroughly plunged, so that the lime is well diffused throughout. Two men are required to put the pack in the pit, one to throw each skin in separately and the second to push it down with a stick. The time required for liming varies according to the weather, in winter twenty-one days being enough, while in summer not more than sixteen days are required. Every other day the skins should be hauled out and the lime plunged. When the first pack has gone through, the second pack should follow into the pit, but it should remain in it only twenty-four hours, when the lime is run off and a new one substituted. Owing to the extremely greasy nature of the skins, it is necessary to give them long liming. In order to produce a firm leather with the requisite hard grain, it is necessary to keep the limes as fresh as possible; old, stale limes produce leather that is tender and has a soft grain.

Unhairing.—The skins are unhaired on the beam; care being taken to rid them of the young hair, which is sometimes difficult to do. After unhairing, the superfluous lime is removed by washing the pack in a wheel. When the water running off is quite clear the skins are ready for puering or bating.

Bating.—Good results are obtained with Dennis' Puerine,

also with Oropon. The skins are to be brought down fairly low; and a good guide to determine when they are low enough is to occasionally take one out and pinch it between the forefinger and thumb. When a decided impression is left on the grain, the process has gone far enough. From two to six hours should bring them down, though large skins require longer treatment. The skins are next scudded over a beam, slate knives being usually used for this, which is an important operation as it removes any free lime or lime salts there may be in the skins.

A bran drench should, previous to scudding, have been made by scalding half a bag of bran and a pailful of pea meal in a paddle. After the scudding, the skins should be thrown into this drum and left in it five or six hours. They are then rinsed in warm water and tanned.

Tanning.—Quebracho extract and sumac are used for tanning the skins. A cube of solid quebracho extract is dissolved in a barrel by boiling. This constitutes a stock solution. A 10-degree barkometer solution of this extract is taken and drummed together with the skins in a closed wheel for one hour, sufficient liquor being used to cover the goods. This sets the grain. The skins are then put into a paddle containing about a 12-degree liquor, and remain in it until they are tanned, the strength of the liquor being gradually increased. Tanning should be completed in a week, which can be tested by cutting off a small piece and observing whether the tan liquor has entirely penetrated the middle of the skin, leaving no white streak. When tanned, the skins are for two or three hours drummed with a liquor made of a half bagful of sumac and a few pailfuls of liquor. They are then struck out on a machine and hung up to dry. When quite dry they are taken down and struck out either by hand or by machine, using hot water to soak them in; then they are hung up to partially dry out. Such edges as are dried out should be redampened with a sponge before resetting the skins on a table. After this resetting, the skins are ready for blacking. Two piles, a dozen skins in each pile, are laid on the table with the necks and

butts running one way, and are dyed with the following materials:

Blacking.—A pailful of good strong logwood liquor, to which a half cupful of ammonia has been added, is heated to the boiling point and applied to the skins with a brush. This is immediately followed by a solution of iron liquor and glue, prepared by pouring 1 gallon of iron liquor over ½ lb. of best glue; this is allowed to stand a few hours and heated up before use. This "floss," as it is commonly called, is put on the skins evenly and thinly, and rubbed in thoroughly. The skins after blacking, are laid face to face, covered up, and allowed to remain over night for the black to set.

They are then grained from angle to angle with a board covered with a piece of thin tin perforated similar to a nutmeg grater. After these two "cuts" they receive another "cut" on the belly with a cork-board, followed by a "cut" straight up the skin; they are dried in a hot room, afterwards "emeried" and seasoned with the following mixture: ¾ pailful of water, 1 quart of blood albumen, 1 pint milk, 1 quart ink. This is applied with a sponge, and the skins are laid face to face until they come to or are dry enough to be glazed. After glazing they are sprung up with a cork-board.

Walrus Grain Seal.—The large sealskins usually used for this kind of work are soaked in the manner that has already been described. In liming them, however, a pound or two, according to the size of the pack, of sodium sulphide is used in conjunction with lime. From ten to sixteen days is enough liming for this class of work.

When unhaired, the skins are washed in water; bated in a strong, old bran bate and brought down in it. They are then taken out and drummed in a hot and fairly strong liquor, which contracts the grain, thus forming the well-known walrus grain. The subsequent tanning is effected in a paddle, and when tanned the skins are hung up, dried, blackened, grained and seasoned.

Splitting.—Heavy skins are split out of the lime, on a belt-knife machine. The substance of the grains and splits varies

according to the requirements of the market. The grains are finished into patent or enameled leather, and also for bookbindings and fancy leather goods. Two thin middle splits and one rough split can, as a rule, be got from each skin; and the "linings" are then usually thrown back into the limes for a couple of days to get rid of as much of the grease as possible, about two days, with one handling, being generally sufficient. The linings are then washed in tepid water, slightly acidified with acetic acid to neutralize any hardness.

Bating, Scudding and Drenching.—The split skins are bated with dog puer or a good substitute, and then drenched in a bran drench. This latter is prepared by scalding enough bran at about 10° below the boiling point. This is cooled down to 95° F. before the skins are put in. If the drench ferments properly, the skins will rise to the top as the gas generates; they should be pushed down until the drenching has been carried far enough, when they are slated out of warm water, and are then ready for tanning.

Tanning Process.—In addition to the process of tanning with quebracho and sumac that has already been described, seal skins may be made into good leather by tanning with gambier and sumac, the liquor being at the beginning about 10° barkometer strength. Care must be taken to insure a sufficiency of acidity, otherwise the skins will fall, and will be flat and papery when finished. After running in this weak liquor for about six hours, the skins are passed into a 20° liquor. It is well to add about 1 quart of acetic acid for every five dozen grains or linings. In this liquor the goods remain about seven hours.

The third liquor should be made up to a strength of 35° barkometer, and about the same amount of acid mentioned above, should be added to it in proportion. It will also help to fill out and improve the goods if a pailful of oak-wood extract is added to the liquor after the skins have been running in it half an hour. If this has been properly carried out, the goods will have been struck through and should be horsed up, and allowed to drain ready for sumacking.

This is best done in a vat, although a paddle is sometimes used. This bath is prepared by adding water at about 125° F. to about 23 lbs. of best Palermo sumac. Cool down to 86° F.; enter the goods and haul up once or twice, warming the liquor each time. After laying in the sumac over night the skins should be horsed up and, after draining, taken to the sheds for drying. Care should be taken not to expose them to strong or harsh winds in the early stages, and the use of steam and artificial heat should as much as possible be avoided.

Tanning the Splits.—The splits may be tanned as follows: Enter them into a liquor made up to about 35° barkometer, with best oak-wood extract and sufficient water. For every five dozen splits add 2 quarts of acetic acid, which helps to maintain the goods in a plump condition. Keep the splits (linings) in this liquor for two days, handling once. Horse up to drain and dry out steadily. Cube gambier costs more than the block gambier, but it is richer in tannin and does not contain dross. The best Sicily sumac should always be used. Low-grade sumac is badly adulterated with lentiscus.

Directions for Finishing.—When the grains are brought down from the shed, they are treated, where weight is a consideration, as follows: For every ten dozen take 28 lbs. of chloride of barium, and with sufficient water to wet them, work the goods in a drum, together with 6 gallons of sumac for an hour at 104° F. From this they are plunged, a dozen at a time, into a weak solution of sulphuric acid, which should taste moderately acid when applied to the tongue. Stir the skins for three or four minutes until they assume a whitish appearance. The chemical action causes the barium chloride to be changed into barium sulphate. After each dozen skins is taken out of the bath sufficient acid should be added to maintain the required acidity.

The skins are now ready for hoisting up and striking up, the latter being done on the grain side in the ordinary way, and the grain is wiped over with best linseed oil. They are then hung up to stiffen sufficient for setting. When ready,

let them lay in piles, after dampening down all dry parts, for a day or two, and then set out lengthwise and after that from neck to butt. Now hang them up and allow them to dry out. When dry, break down with graining board, pushing the goods upon the flesh side from neck to butt, and turning and doing the same on the grain side. Fluffing or buffing follows. This should be effected on a fine emery wheel and done crossways, commencing at the butt, going about half across, turning round and reversing. Now draw the skins straight down on the grain.

Treatment for Split Linings.—The linings, after being dried out, may be weighted by drawing them through a strong solution of chloride of barium, as above described, but they must be drawn through the acid bath one at a time, if tearing is to be avoided. Now wash them with warm water and lightly strike out with a suitable ridging board. The splits are then ready for staining, and when dry are buffed on one side and enameled on the other.

The goods may also be utilized for colors by soaking in warm water, running them through a weak acid bath and dyeing in a paddle at 115° F. If acid dye is used the goods can be dyed at once; if dyeing is effected with basic dye the tannin should be fixed with tartar emetic. After dyeing to shade, wash in cold water, run out with the ridging board and tack out, taking care that the goods are not dried too rapidly, moderate heat being preferable. When dry they are taken off the frames or boards and the side that is to be faced is filled up with a potato-flour paste, made by adding sufficient of the farina to water to form a stiff paste. When the paste is cold, add a little color and apply a good coat of it, after which tack the goods on the straining frames or boards. When dry, season them with albumen seasoning, made by soaking 6 ozs. of albumen in cold water over night and making up to 2 gallons, adding a pint of milk. Apply the seasoning lightly with a soft sponge. Hang the goods up until they are in condition for glazing, and then glaze them for the final finishing.

The splits, after being struck out and tacked, are stripped from the straining frames and then rolled to flatten down the rough surface. They are next stained, which may be done as follows: In 3 gallons of boiling water in a pail dissolve 3 ozs. of dye, stirring until all is dissolved. Now strain the solution through cheesecloth doubled a few times. A mixture of one of the fast browns and yellows will, after one or two experiments on a small scale, produce the shade required. While the dye liquor is hot, add to it about 6 ozs. of dissolved starch. This will slightly thicken the dye, which even with this addition will penetrate very rapidly, and consequently should be spread quickly and evenly with a suitable brush.

Finishing Operations.—Finishing this class of goods is a simple matter when the proper finish is used. The following finish has been found to work very well in practice if brushed on carefully and the linings are hung up until they are nearly dry and in the right condition for rolling. Boil for an hour or so 2 lbs. of Irish moss and 4 pints of flaxseed in a steam-jacket pan. Then add 1 lb. of gelatine which has been soaked over night in a little water, and ¼ lb. of curd soap. The boiling should be carried on long enough to extract all the mucilage in the flaxseed and moss; the mixture is then squeezed through a fine meshed bag. The seasoning is applied cold, or nearly so, after which the splits are well rolled under the jack, and when trimmed they are ready for use for shoe linings, valises and other articles.

Splits for White Shoes.—For sporting and athletic shoes, seal splits are frequently sold as a good imitation of the real deer-skin article. These goods are treated as above described so far as soaking, liming, bating and drenching are concerned. Only the best and stoutest splits are selected for this purpose. After drenching, the splits are washed in warm water and placed in a pickle made as follows: For every 100 lbs. of them, cook until dissolved 20 lbs. of alum and 14 lbs. of salt. Use at 95° F., and drum the goods with it one hour. Then add a mixture of flour, eggyolk and china clay made as follows: Mix 35 lbs. of flour with enough water at 95° F. to form a

stiffish paste, and add ½ gallon of eggyolk and about 5 lbs. of china clay. No oil or grease is necessary as seal splits are naturally greasy.

To apply this dressing it is best to stop the mill and to add about half the paste to the goods. Drum for fifteen minutes, then add the rest of the paste, and drum two hours. Now take the splits from the mill, double them across and spread them out in a vat or tub. The liquor in the mill is then poured over them and they are allowed to lay in this three days, hauling up once a day and allowing to drain. After the final draining, tack on frames or boards and dry quickly. If this is not done the result will be poor, as the alum and salt will not be fixed properly, and the finished leather will be flat and tinny.

The splits are now allowed to lie in a cool place for two or three weeks to feed and mellow, and they are then staked. Damp down first by draining through the liquor they lay in, after making up to a convenient quantity with water. Lay them in a pile until they are in good condition for staking, which is best done in the old-fashioned way by hand, although it is possible to do good work by machinery under suitable conditions. The splits are then dried and worked out on the perch with the old arm-crutch stake. Now carefully run them on the emery wheel, using fine emery. Commence at the butt and work about half-way across, and then turn them and do the other side in the same way. Now turn over and repeat the operation as before, and a fine, velvety fiber will be the result. After being again placed in the perch, rubbed over with whitening and finally worked out well with the hand-scouring tool, the splits are ready for the shoe manufacturer.

THE MANUFACTURE OF PIGSKIN LEATHER.

Pigskins have from time immemorial been used for many purposes; at the present time they are employed more extensively than ever. When properly tanned they are as durable as goatskins, as pliable as calfskins, and present a peculiarly attractive appearance. They are finished in russet and colors,

and are used for innersoling, saddles, traveling-bags, pocket-books, belts, jewelry cases, book-bindings, sporting goods, shoes, slippers, suspenders, leggings, military equipments, trusses, wall decorations, screens, and for upholstering, carriage and automobile trimmings. A few ways of tanning them will be described.

Washing and Degreasing.—Pigskins contain a grease that has to be gotten rid of before they are limed or the leather will be greasy and hard. After having been scraped out dry before soaking, the skins are washed in a warm solution of sal soda. Put about 5 lbs. of sal soda into a barrelful of water heated to 95° F. Place the skins, one at a time, in this water, leave them therein long enough to get soaked through and then put them on the beam and strike them out thoroughly with a dull knife, bearing on hard and forcing out as much of the grease as possible. This should be done two or three times. The skins are then rinsed off in warm water and soaked some hours in cold water before they are unhaired and limed. A great deal of grease can be forced out of them by thus passing them through the warm solution of sal soda and then working them out on the beam. The skins are next soaked, fleshed and unhaired.

Unhairing.—Run 700 gallons of water into a paddle and add to it 100 lbs. of depilatory crystals dissolved in hot water. Put a pack of skins into this liquor and leave them therein until the hair is dissolved, when they are ready to be limed. Sulphide of sodium—1 lb. for every 7 gallons of water—may be used in this process, either in a vat or in a drum. The liquor swells the skins and dissolves the hair. The next process is liming.

Liming.—Slake 100 lbs. of lime and add to it 700 gallons of water. Put the unhaired skins into this liquor and turn them in it two or three days, then wash them and scrape the flesh side again. Some of the hairs that may be broken on the grain should be removed from the flesh side and much of the remaining grease will at the same time come out. The skins are then in condition to be bated.

Bating.—Prepare a paddle vat with water warmed to 120° F. Put into the water two pailfuls of dry bran and allow to stand over night. In the morning bring the temperature up to 95° F., and add 1 pint of lactic acid to the bran liquor. Throw a suitable number of skins into the liquor and then add another pint of lactic acid. Run the paddle from three to five hours, then wash the skins. They should be thoroughly worked out of the drench and all lime and grease forced out. Work them over a beam with a union worker, and they are then ready for the scudding table. Use a hand glass and set with dull, smooth edge as the grain is easily damaged. After working out the grain, the skins should be rinsed in warm water and tanned.

Tanning.—Quebracho extract makes a satisfactory tannage for pigskins. Prepare a liquor by adding enough dissolved extract to 700 gallons of water in a paddle to make a 4-degree barkometer liquor. To this liquor add 10 lbs. of alum and 25 lbs. of salt dissolved in hot water. Plunge the liquor until it is thoroughly mixed. Start the wheel, throw in the skins and turn them thirty-six hours or longer, which strikes them a light oak color, and they may then be placed in the second bath, which should consist of clear quebracho liquor. Add enough dissolved extract to the water in the paddle to make a 6-degree liquor, leaving out alum and salt. Turn the skins thirty-six hours; then strengthen the liquor to 10 degrees and leave the skins in the liquor for two days, which completes the tanning. The second liquor may also be given the skins in a drum. A mixture of quebracho and hemlock extracts may be used; also a mixture of hemlock and oak extracts.

When the skins are tanned, pass them into a sumac liquor in a paddle or vat. The liquor is prepared by adding water at 122° F. to 25 lbs. of sumac. Cool down to 86° F. before entering the goods, and haul up once or twice, warming the liquor each time. After being in the sumac liquor over night, the skins are struck out and oiled with neatsfoot oil or sulphonated oil on the grain, and hung up to dry or tacked on

frames. When dry, they are staked and boarded and are then ready for the finish. The leather can be bleached if a lighter color is wanted, or colored any shade, or dyed black.

Quebracho tan makes a fine, natural grain, free from spew, and firm, strong leather. For bag leather, hemlock extract is a good tannage; also hemlock and quebracho. The skins are started in a weak liquor, which is strengthened twice a day, until they are struck through, which takes about eight days. After tanning, they may be bleached like skirting leather and drummed in a sumac bath. Next wash them with clean water; slick them out; give them a little oil and hang them up to dry. After drying, dampen and shave those that need to be shaved and then apply fat-liquor. Make the fat-liquor of soap, oil and degras, the same as for calfskins, giving the leather about half as much liquor as calfskins.

Dry the leather and store it away for a while to mellow. Then, if it is to be colored, dampen it and clean the grain with borax and sulphuric acid. To do this, wash the leather in a drum in a warm solution of borax for fifteen minutes. Drain the solution out of the drum and run the skins in a solution of sulphuric acid, made by adding enough acid to water to make a liquor sharp enough to bite the tongue. Drum them in this solution, then wash them and run them in sumac again. After having been rinsed they are in condition to be colored. When colored, give them a light coat of cod oil and dry them. Staking, boarding and glazing complete the process. Pigskins for bag leather should be quite firm and solid.

If the grain is greasy a drumming, previous to coloring, in lactic acid solution or with borax or soda, clears the grain so that uniform coloring becomes more possible.

If black leather with undyed flesh is wanted, the skins should be dyed on the grain side only by the staining method. A solution of 1 lb. of Leather Black T B (Casella) in 10 gallons of water is recommended for this purpose. It is brushed onto the grain, two applications being usually sufficient.

Pigskins are much used in plain russet finish. For this they need to be bleached according to the instructions given

for bleaching russet leather. For innersoling, the skins are oiled with a mixture of fish and mineral oils, and finished by rolling under the rolling machine.

Tanning with Sumac, Oak Bark and Alum.—A soft, light-colored pigskin can be secured by tanning in the following manner: Pickle the skins with sulphuric acid and salt to bleach them, next remove the acid in a drench of whiting and salt, and then wash them in two baths of warm salt water. To make the tan liquor, dissolve in 6 gallons of water 6 lbs. of alum, 4 lbs. of Glauber's salt and 4 lbs. of common salt. In another tub boil in 5 gallons of water, 5 lbs. of ground sumac, 3 lbs. of oak bark and 1 lb. of ground nutgalls. Mix the two solutions; strain the mixture while it is hot and add to it 4 ozs. of sulphuric acid. The liquor should be used luke-warm; and the skins be drummed in it several hours, then allowed to drain twenty-four hours. Tanning can also be effected in a paddle.

After draining, the skins should be struck out on both sides and oiled quite heavily and dried. As they dry they should be staked so that when the leather is dry it is soft and pliable. It can be easily colored any shade. It is quite waterproof and durable. Oak bark is an especially good tannage for pigskins; chestnut extract also.

Another method of tanning with quebracho and sumac is carried out as follows: A cube of solid quebracho extract is dissolved in a barrel by boiling, forming a stock solution. A 10-degree barkometer solution of this extract is taken and drummed together with the skins in a closed drum for one-half hour or longer. This sets the grain. The skins are then put into a paddle, containing a 12-degree liquor, and remain in it until they are tanned. The strength of the liquor is gradually increased. When tanned, the skins are drummed with sumac liquor for two or three hours; they are then struck out on a machine and hung up to dry. For black leather the skins may be handled and blacked in the same manner as sealskins.

White Pigskins.—If white pigskin leather is wanted, the

skins should be tanned in an alum and salt tannage or with sulphate of alumina. It is also practicable to tan them with formaldehyde the same as calfskins. The white leather can be finished in the white and can can also be easily colored light and fancy shades. Thorough work in the beamhouse is the basis of such leather. Not only must the skins be soaked in sal-soda water and worked over the beam to rid them of as much grease as possible, but they should also be quite heavily limed and bated, and then worked out again so as to be as clean as possible before tanning is begun. If they are not too full of holes, pickling and tanning can be done most advantageously in a drum. To pickle 100 lbs. of them use 1 lb. of sulphuric acid, 15 lbs. of salt and 15 gallons of water and drum the skins in this liquor one hour, then place them over a horse to drain twelve hours before tanning them.

Prepare the tan liquor by boiling 12 lbs. of sulphate of alumina in 10 gallons of water. In a pail dissolve by boiling in 1 gallon of water 1½ lbs. of bicarbonate of soda. Pour the soda solution slowly and with constant stirring into the alumina solution. Care must be taken to pour the soda solution in carefully, for if it is added too rapidly the tan liquor will be spoiled. The mixture should be used cold.

Tanning is effected as follows: Put the pickled skins into a drum together with 10 gallons of water in which 1 lb. of Glauber's salt and 3 lbs. of common salt have been dissolved, these quantities being used for 100 lbs. of skins. Drum them with this solution twenty minutes; then stop the drum and and drain off the liquor. Then put the plug back and throw in 10 gallons of water at 75° F., and 40 lbs. of salt; start the drum and run it fifteen minutes.

At the end of fifteen minutes pour one-half of the alumina and soda solution into the drum and drum three hours. Drain the skins over a horse until the next day and then hang them up to dry. When dry, put them back into the drum together with 8 gallons of water and drum ten minutes; then add the other half of the alumina and soda liquor and run the skins in it three hours. Drain them twenty-four

hours, then hang them up to dry. It is advisable to keep them in the dry condition some time before finishing them.

When it is desired to fat-liquor and finish them, soften them with warm water and put them into the drum together with a solution of acid fat-liquor or sulphonated castor oil, and run them in it forty minutes. Dissolve 7 or 8 lbs. of the soluble oil in 8 gallons of water at 95° F. for 100 lbs. of dry skins. After the leather has absorbed the fat-liquor, let it drain over night; then strike it out and apply a mixture of glycerine and water into which French chalk has been stirred. Give the grain a liberal coat of this dressing and hang the skins up to dry. Dampening and staking complete the process. It the leather is not fully tanned it can be retanned with alumina and soda; also given more fat-liquor if it seems to require it. Nice white leather results from this tannage when the preparatory work is done as it should be.

THE TANNING OF BUCKSKINS.

The preparatory treatment of deerskins is about the same as the treatment of sheepskins. Green skins are soaked a few hours and fleshed. As they are very buoyant and will not stay under the water from their own weight, it is necessary to place some sort of weight upon them to keep them under water. For dry skins a sulphide soak should be used and the skins thoroughly softened before they are put into lime or painted with depilatory paint.

For the purpose of removing the hair two methods can be followed: The skins may be painted with a mixture of lime and sodium sulphide, or one of lime and red arsenic, the same as sheepskins; then unhaired and limed a few days. Another method is to place the skins in lime about the same as calfskins, using lime and sulphide of sodium; unhairing in the usual manner and then bating the skins.

Deliming is effected by bating or drenching the skins with the same materials that are used in deliming sheepskins; the goods are then pickled and tanned.

White Buckskin.—1. A well-tanned, soft and white buck-

skin is obtained by tanning with a basic solution of sulphate of alumina. The skins, limed, bated and pickled with sulphuric acid and salt, are weighed and the proportions of tanning materials are based on 100 lbs. of them. Dissolve by boiling in 10 gallons of water 12 lbs. of sulphate of alumina; in another vessel dissolve in boiling water 24 ozs. of bicarbonate of soda. Add the soda solution very slowly to the alumina solution, stirring constantly and allowing intervals for the effervescence to subside. Allow the liquor to cool before using it.

Drum the pickled skins twenty minutes in a solution of 1 lb. of Glauber's salt and 3 lbs. of common salt in 10 gallons of water; then drain the liquor out of the drum and put in 10 gallons of lukewarm water and 4 lbs. of salt, and run the drum fifteen minutes. Then without stopping the drum pour into it half of the alumina-soda solution and drum three hours. Take the skins out and horse them up over night, then hang them up to dry. When dry put them back into the drum together with 8 gallons of water and drum ten minutes. Then add the other half of the alumina and soda liquor and let the drum run three hours. Horse the goods up twenty-four hours and then dry them out.

Fat-liquoring with acid fat-liquor is the next process. For each 100 lbs. of dry skins use 6 or 7 lbs. of sulphonated oil and stir it into 8 gallons of water at 95° F. Drum the leather with this fat-liquor forty minutes. The amount of oil mentioned is the maximum; in most cases a smaller quantity will be sufficient. Some flour may be made into a paste with cold water and added to the fat-liquor to give fullness to the leather. The grain is next set out and given a coat of French chalk, 2 parts of glycerine and 4 parts of water, and the skins are then dried, dampened and staked and buffed on grain or flesh as may be desired.

2. An alum tannage is carried out in the following manner, resulting in soft, white leather, the quantities mentioned being for 100 lbs. of pickled skins: Make a paste of 5 lbs. of flour and a small amount of water. Dissolve 3 lbs. of sulphate of

alumina and 2 lbs. of salt in 3 gallons of water; add to this slowly 4 ozs. of bicarbonate of soda, and then mix in 1½ lbs. of eggyolk and 1 lb. of olive oil. Add the flour paste and drum the skins with the mixture for two or three hours. Leave them in the liquor over night, and hang up the next day to dry. Dampen, stake and dry the goods, then buff them and drum them with 2 lbs. of eggyolk or sulphonated oil and 5 lbs. French chalk. Set the leather out, tack and dry it. Any shade of color, grey, tan, etc., can be obtained by applying in the usual manner the suitable wood dyes or artificial dyestuffs.

3. A white leather is also made by tanning the skins with formaldehyde; and by adding a little moellon of the first quality to the soap fat-liquor very supple skins of a light yellow color are obtained. Neatsfoot oil and cod oil, as well as sulphonated oil, produce white skins. The skins are limed, unhaired, bated and washed but not pickled. For each 100 parts by weight of them, dissolve 1 part of formaldehyde, i. e., about 2½ parts of commercial formaldehyde, in a convenient quantity of water in a paddle. The skins are left in the liquor from twenty-four to forty-eight hours, when they are neutralized, washed and fat-liquored with soap for white leather, or with soap and moellon, or with moellon alone, for a yellow shade.

Where the grain has been removed the skins tan very rapidly. The leather resembles alum-tanned goods, being of nice white color and soft and supple. Sulphonated oil serves as a fat-liquor; also soap and moellon. Finishing consists of staking and working out.

Chrome-tanned Buckskin.—The skins, after the final washing, are pickled either with sulphuric acid and salt, or with sulphate of alumina and salt. The acid pickle consists of 15 gallons of water, from 1 to 2 lbs. of sulphuric acid and 20 lbs. of salt for 100 lbs. of skins. The goods and 12 gallons of water and 5 lbs. of salt are thrown into the drum and drummed a few minutes. The acid and the rest of the salt in 3 gallons of water are then poured into the drum and the

drumming is continued one-half hour. The goods are then allowed to drain until the next day, when they are tanned in a one-bath or a two-bath process.

The sulphate of alumina pickle consists of 4 lbs. of the alumina and 4 lbs. of salt in 10 gallons of water. Drum one-half hour; drain and tan.

1. Excellent chrome buckskin is obtained by tanning the pickled skins in a two-bath process. Weigh the pack of skins, and for each 100 lbs. of them use 6 lbs. of bichromate of soda, 4 lbs. of salt, 3 lbs. of muriatic acid and 15 gallons of water. Drum the skins in this solution from one to two hours, and drain them over night.

The second bath is prepared by dissolving 12 lbs. of hyposulphite of soda, 3 lbs. of salt and 6 lbs. of muriatic acid in 15 gallons of water, and drumming the previously chromed skins two hours; horsing up over night and neutralizing the next day.

2. The one-bath method is as follows: The pickled skins are placed in the drum together with 8 gallons of water and 6 lbs. of salt and drummed fifteen minutes. One-bath chrome liquor is then added, and the skins are drummed until they are tanned throughout. A solution of 8 ozs. of bicarbonate of soda in a little water is then poured into the drum; after a further drumming of two hours, a solution of 6 ozs. of the soda is poured into the drum, and the goods are drummed two hours longer.

After draining forty-eight hours, the leather is washed in a solution of 1 lb. of borax for one-half hour, then in clean water for one-half hour, set out and shaved.

White Chrome Buckskin.—An excellent white buckskin is made by tanning with one-bath chrome liquor and then bleaching with borax and sulphuric acid, or by treating the skins with flour. When fully tanned, wash the skins in a fairly strong and hot solution of borax for one-half hour; then prepare a solution of sulphuric acid and water by adding acid to water until the latter is as sour as a lemon. Wash the previously washed leather in this acid bath twenty minutes;

then wash it in clear water and fat-liquor it with acid fat-liquor. Drumming the skins with flour is another way to make it white. The flour treatment can be used alone, or it can follow the borax-acid wash. The leather is washed after tanning and then given the flour treatment, about 50 lbs. of flour stirred into a thin paste with water being used for 100 or more skins. The leather is drummed in the flour two hours; it is then fat-liquored and dried.

Finishing consists of staking the leather and milling it with powdered chalk or soapstone, after which it is ready for use. The flesh should be buffed clean and smooth and if a leather without a grain is wanted, the grain should be removed either in the beamhouse or by buffing on an emery or carborundum wheel.

Colored Chrome Buckskin.—Chrome-tanned buckskins are colored in the same manner as chrome sheepskins, with acid and basic dyestuffs. The addition of 3 or 4 ozs. of ammonia to the dyebath insures good penetration, formic acid being used to develop the color upon the skins. A decoction of sumac added to the dyebath increases the fullness of the leather. Fat-liquoring may be done either before or after dyeing. A black color throughout the skin is obtained by using in a drum direct black, to which some logwood has been added to give greater fullness to the stock.

Fat-Liquoring.—Any one of the various fat-liquors recommended for sheepskins may be applied to buckskins, the following being especially recommended: Olive oil soap, 1 lb.; borax, 2 ozs.; neatsfoot oil, ½ lb.; eggyolk 1½ lbs. Make into 12 gallons of liquor and use at 125° F. for 100 lbs. of leather.

HOW TO TAN SNAKE SKINS.

Tanning with Alum and Salt.—The skins of snakes, like all other skins, should be soaked in water until they are soft, then broken or fleshed on the beam, and put back into the water for a few hours. They are then pickled with sulphuric acid and salt, after which they are placed in a solution of equal parts of alum and salt, in which they remain over night or

longer. A basic solution of sulphate of alumina and soda, as described for alum-tanned sheepskins may be used for tanning. The skins are next hung up to dry, and when dry are run with moist sawdust until all the scales are off; they are then worked out carefully and dried.

Tanning with Bark or Extract.—Snake skins can be tanned in bark or extract liquors the same as calfskins and sheepskins, beginning with weak liquor, handling often, and increasing the strength daily. While soaking, they should be worked by hand until they are soft and flexible and the outer scales have been removed; they are then in condition to be tanned. Gambier, sumac, quebracho, chestnut extract or a combination liquor may be used. The tanned skin is soft and flexible and the natural colors are changed but little.

A process of tanning with alum, salt and gambier is carried out in the following manner: The skin is soaked in the usual way. It is then fleshed and put into lime for four or five days until the outer scales can be removed. It is then bran drenched and depleted, washed and pickled for two days with a salt and alum liquor of 1 part alum, 2 parts salt and sufficient water to cover. Tanning is then started in a 5 per cent. gambier liquor, which is strengthened daily until it reaches 10 per cent. The skin is tanned in a few days. Quebracho extract or chestnut extract may be used in the same manner as gambier. After the tanning is completed, the skin is fat-liquored with sulphonated oil, dried, wet down, shaved, sumacked, oiled again if necessary, stretched out carefully, and dried. The flesh may be made clean and smooth with sandpaper or on an emery wheel. A bright finish is obtained with casein or shellac; a dull finish with flaxseed gum or gum tragacanth.

NOTES AND RECEIPTS FOR FINISHING LEATHER.

Seasoning for Glazed Chrome Upper Leather.—Blood albumen, 100 parts; logwood extract, 10 parts; redwood extract, 2 parts; ammonia (10 per cent.), 30 parts; chloroform, 2 parts; water, 1000 parts.

The albumen is dissolved in water to which the ammonia has been added, and the chloroform is added as a preservative. Before being used, the liquor should be strained and diluted with water.

The second seasoning, which is applied after the leather has been seasoned with the above mentioned dressing and glazed, is made of: Bullock's blood, 300 parts; milk, 100 parts; log-wood liquor, 100 parts; copperas solution, 100 parts; copper sulphate solution, 100 parts; nigrosine solution, 100 parts; ammonia, 3 parts; formaldehyde, $\frac{1}{8}$ part.

Bright Blacking Varnish for Shoe Leather.—This varnish is useful in producing a bright polish on grain shoe leather of any tannage. Dissolve in a bottle, tightly corked, 1 oz. of caoutchouc in 1 oz. of carbon bisulphide and let the solution stand a few days. Next dissolve 3 ozs. of orange shellac, $\frac{1}{2}$ oz. of gum sandarac, $1\frac{1}{2}$ ozs. of gum mastic and 5 ozs. of pure Venetian turpentine in 2 quarts of alcohol. Add the turpentine after the other gums are dissolved. When all three materials are well mixed, add the caoutchouc solution. Put the vessel containing the complete mixture in another vessel of hot water and heat to about 120° F. Then add 1 oz. of black aniline. Keep the whole for about an hour in water at 120° F. Then put it in a jar, cork tightly, and let it stand at least two weeks before using. It improves with age.

For use, dissolve 2 ozs. of gelatine (isinglass) by boiling in 1 quart of water. To this solution add 1 oz. of indigo blue and 2 quarts of cold water. Let the solution cool, and place it so as to be able to see that the mixture is not too thick, as the heat of the shop or summer weather has much to do with the amount of water the gelatine will absorb. The mixture should be like thin jelly. It is prepared by heating the gelatine a little and straining through cheesecloth; then mix equal parts of alcohol, gum and gelatine and stir until the mixture gets thick. While stirring add to each gallon of the mixture $1\frac{1}{2}$ ozs. of glycerine. When well set the mixture is ready to be applied to the leather.

Two thin coats should be evenly spread on the grain with

a sponge and well rubbed in with a fine sponge or with a soft hair brush in a warm room. Let the first coat get dried in before applying the second. After the last coat is absorbed, glaze the leather slightly by hand so as to produce the soft feel the stock had before the varnish was applied. If these instructions are carefully carried out the leather will have a pleasing finish.

Waterproof Leather Dressing.—Petrolatum, 4 lbs.; Burgundy pitch, 4 ozs.; rosin, 2 ozs.; ivory black (dry), 6 ozs.; beeswax, 4 ozs. Melt the rosin, pitch and beeswax together, then add the petrolatum and when it is melted, stir in the ivory black and continue stirring until the mixture is cold.

Apply the dressing to the leather with a soft cloth and rub it in well. If the leather is dirty, wash it with a sponge and a little soap before applying the dressing. It gives a nice black but not a polish. If used properly, it will make leather soft and pliable, no matter how hard or watersoaked it has become. A strap treated in this way may be immersed in water a week without absorbing any of it. Used as shoe dressing it renders the wearing of rubbers unnecessary.

Harness Blacking.—Mutton suet, 2 ozs.; yellow wax, 6 ozs.; powdered sugar, 4 ozs.; yellow soap, 2 ozs.; lampblack, 1 oz.; indigo (powdered bluing) 4 ozs.; oil of turpentine, 4 ozs. Dissolve the soap in the water; add the other ingredients except the turpentine; melt and mix thoroughly together; then add the turpentine. This mixture is applied with a sponge and polished with a brush.

Oil Black.—Lampblack, 20 lbs.; logwood extract, $2\frac{1}{2}$ lbs.; tallow, 70 lbs.; good bark liquor, 12 gallons. After mixing, boil for twelve hours, and when cool, stir well to keep from separating. This black may be varied more or less to suit different leathers, the same as finishes, as no one finish works the same on all kinds of stock, and should be modified to get the best results.

Blacking for Vegetable-tanned Leather.—This is a good blacking for heavy shoe and harness leather. Copperas, 9 lbs.; Epsom salts, 4 ozs.; acetic acid, 6 ozs.; nutgalls, 1 oz. Put

these ingredients into 2 gallons of soft water and boil until dissolved. Then put the solution into a barrel and add 40 gallons of water; stir thoroughly and the blacking is ready for use.

If the leather has a loose, open grain it is advisable to put into the barrel 4 or 5 gallons of strong gambier liquor in place of the same amount of water. This will tighten up the grain and prevent it from piping when finished.

Another good receipt is: One barrelful of gambier liquor showing 10° test by the barkometer. To this add 15 pounds of copperas, 2 lbs. of epsom salts, and 4 ozs. of powdered nutgalls. Dissolve first the copperas and nutgalls in a pailful of hot water and add the solution to the gambier liquor. This is particularly suitable for quebracho-tanned harness leather.

Sigs for Greasy Leather.—1. To make one barrelful of sig to clear the grain of greasy leather before applying logwood: Salts of tartar, 12 lbs.; bichromate of potash, 5 lbs.; ammonia 26°, 1 quart; water, 40 gallons. Boil the salts of tartar and bichromate of potash in 12 gallons of water; when dissolved, add water to make 40 gallons, and then add the ammonia, stirring thoroughly. If kept for any length of time it may be necessary to add more ammonia.

2. An excellent sig is made as follows: Use a fifty-gallon barrel and boil in 12 gallons of water, caustic soda, 12 ozs.; salts of tartar, 12 ozs. When dissolved, fill the barrel with cold water.

Logwood Liquor.—To make a logwood liquor of logwood crystals, hemolin or other logwood dye, use 5 lbs. of the crystals and boil them in 20 gallons of water until dissolved; then fill the barrel up with water, adding sal soda, borax or other alkali to effect easy penetration, say from 8 ozs. to 1 lb. to the barrel of dye. Greasy leather requires more sal soda in the dye than leather that is not greasy; a sig is also usually necessary. 1½ lbs. of logwood crystals and 3 or 4 ozs. of alkali made into 12 gallons of liquor will color 100 lbs. of leather. The black color may be intensified by the addition of a few ounces of fustic paste to the logwood liquor.

Dyeing Chrome Leather Black.—This process of dyeing leather black may be used upon any kind of chrome leather. The quantities of materials given are for 100 lbs. of shaved leather.

Logwood crystals, 1½ lbs.; black nigrosine, 1 oz.; acetic acid, 1½ ozs.; nitrate of iron, 3 ozs. Boil the logwood in 3 gallons of water, then add 4 gallons of water and drum the leather in the solution ten minutes. Next dissolve the nigrosine in hot water and add it to the contents of the drum and drum ten minutes. In the meantime dissolve the acid and nitrate of iron in 2 gallons of water. Pour this solution into the drum at the end of the second ten minutes, and allow the drum to rotate twenty minutes longer. The liquor should then be run off, and the leather be washed and fat-liquored.

Boiling Logwood Chips.—Put the chips loosely into a coarse bag, tie it and put it into the water. Turn on steam and boil thoroughly. When sufficiently boiled the chips have to be at once taken out of the liquor, as if left in they absorb the color from the solution. Some of the sal-soda or borax used to cut the grease should be dissolved in the liquor before the chips are taken out. When they are boiled loosely in the liquor the latter should be strained immediately after boiling to remove them. Copper pipe or coil should be used, since iron pipe, especially a rusty one, causes a defective color.

Blue Flesh with Nigrosine.—For one dozen chrome sides or an equivalent number of skins dissolve 8 ozs. of nigrosine P. in water at 125° F., and drum the leather with this solution twenty minutes. Now drain off the water, press or strike out the leather and fat-liquor it. Then black the grain with logwood and striker; oil it and dry the leather for the final finishing. The back of the leather will be dark blue and the grain jet black as the result of this method of dyeing.

Strikers for Table Dyeing.—Dissolve 4½ lbs. of copperas and 1½ lbs. of blue vitriol by boiling in half a barrelful of water; then fill the barrel up to fifty gallons. For use on a machine, dissolve 12 lbs. of copperas and 4 lbs. of blue vitriol for each barrel. To the above add 1½ lbs. of nutgalls and 1 lb. of

Epsom salts to each 6 lbs. of copperas and blue vitriol combined. Use this liquor after logwood to develop the black.

Blacking for the Edge of Chrome Leather.—The edges of chrome harness and other leathers can be blacked with a blacking made as follows: Boil 2 lbs. of logwood crystals, 1¼ lbs. of black nigrosine and 1½ lbs. of sal-soda in 9 gallons of water and allow to cool. Boil 1½ ozs. of blue vitriol and 1 oz. of bichromate of potash in 3 quarts of water and stir this into the logwood liquor. Stir the blacking, add 1 pint of ammonia, and then enough water to make 12 gallons of blacking.

Preparing Blood for Leather Finishes.—Thoroughly clean a barrel with hot water and borax and fill it half full of fresh beef blood. Then take a stick or a broom-handle and beat the blood well for twenty minutes. By this heavy beating the fibrin begins to thicken very soon, and it can then be removed with a shovel.

The remaining fluid blood is purified and is called *defibrined blood* because the fibrin, the portion that wastes away, has been removed. To preserve the blood, 1 pint of pyrogallic acid is added to a barrelful of it and mixed by stirring for several minutes. The blood must be kept in a cool place, and the barrel should always be closed after a supply has been taken out. The defibrined blood will keep for almost a year, and will furnish bright and lasting finishes.

Carbolic acid and formaldehyde are of service in preserving blood for leather finishes. Dissolve 1 lb. of carbolic acid crystals and stir the solution into a barrelful of the blood. Five drops of formaldehyde stirred into a quart of blood also hinders the deterioration of the latter. Blood albumen is used in finishing dark-colored leather. It is soaked for several hours in cold or tepid water with the addition of a little ammonia. Blood, which is used only for blacks, may be diluted for use and a little ammonia added. A logwood decoction containing ammonia is added to the blood until the change in color has just set in, the requisite quantity of dyestuff dissolved in water being finally added. A small addition of gelatine dissolved in water enhances the glaze.

Final Dressing for Box Calf.—Dissolve 5 ozs. of extract of archil in 1 pint of warm water. When thoroughly dissolved mix both solutions together by shaking vigorously in a tightly corked jar.

Ointment for Chrome Sores.—An ointment which is said to be a very efficacious preventive of chrome sores is composed of petrolatum, 3 parts; lanolin, 1 part.

Melt on a water-bath or stove; when melted and thoroughly mixed add five drops of 90 per cent. pure carbolic acid to every 4 ozs. of the mixture. Pour the latter into a glass or earthenware jar and allow it to solidify; it is then ready for use.

The ointment should be applied as follows: Let the workman clean his hands and arms thoroughly with soap and water. Rinse with warm water, and while the skin is moist apply the ointment. Rub in well so as to cover all exposed skin for two or three minutes; then wipe dry with a clean cloth. To prevent chrome sores, apply the ointment twice daily. This ointment is also used for burns, scalds, chapped hands, etc.

A five per cent. solution of sodium bisulphite is recommended by Herman S. Riederer, Ph.D., as a wash for chrome sores. It should be applied two or three times a day.

Treatment for Acid Burns.—Strong acids, such as sulphuric and muriatic, coming into contact with the skin cause great pain and destroy the tissue. Dilute ammonia, chalk, carbonate of magnesia, or some other alkali should be at once applied to neutralize the acid. After an hour or so apply the following mixture: Olive oil, 2 ozs.; lime water, 2 ozs.; carbolic acid, 15 drops. Wet a soft cloth with this mixture and apply, changing the dressing two or three times a day. Linseed oil may be used in place of olive oil.

How to Remove Stains from the Hands.—Moisten slightly in the palm of the hand a teaspoonful of permanganate of potash; rub it thoroughly into the skin and then wash off. By the subsequent use of bisulphite of soda the permanganate is completely removed, together with all aniline stains, etc. This

treatment makes the hands soft and white and does not injure the skin.

To Keep Patent Leather Soft and to Restore the Gloss.—Add to some pure wax, melted in a dish set in a pan of boiling water, some olive oil and then some lard. Mix thoroughly by stirring over a fire. Add some oil of turpentine and a little oil of lavender. This will form a paste which should be put in boxes. Apply with a soft rag; rub with flannel.

To Remove Grease Spots from Leather.—If the spots are not very large they may be removed by laying blotting paper on them and ironing out with a hot steel. The heat dissolves the grease and causes it to pass from the leather into the paper. By repeating this process the grease spots may be removed without injuring the leather.

Another process consists of preparing a dough composed of 1 part cooked smashed potatoes and 2 parts mustard flour prepared with turpentine. This is put onto the grease spot and allowed to dry. Then rub it off, clean the spot with a rag dipped into wine vinegar, and finally wash with lukewarm water.

WATERPROOF LEATHER WITHOUT OILY SURFACE.

It is well known that leather exhibits greater firmness and toughness the less the fibers of the hides are changed during tanning. It is also known that the firmness of leather may be considerably increased and it may be made very waterproof by being impregnated with substances such as stearin and paraffin.

The following process consists in treating leather, which has been tanned by a suitable method, or even only by vegetable substances, and which after having been dried, has been impregnated with saponifiable and unsaponifiable substances, such as stearin and paraffin, first for one-third of an hour in an alkaline bath preferably of caustic soda or the like, at a strength of 5° to 10° Bé., the saponifiable substances found on the surface being thereby saponified and changed so that they may be removed by a simple washing. In consequence of

this the leather entirely loses on the outside its greasy character without losing the fulness and firmness imparted to it by the impregnation, and may then be bleached and retanned on the surfaces. The extraordinary waterproofness of the leather prevents any damage from the alkali.

The treatment for one-third hour of the sides with a sulphuric acid solution of 5° to 10° Bé. strength which then follows, causes the free alkaline salts still contained in or upon the leather and the metal salts derived from the tannage to be neutralized and rendered non-deleterious and the leather is also thereby brightened. The process is carried out approximately as follows: The hides which have been treated as usual are subjected in a raw or chemically tanned condition to a weak vegetable final tanning. After bleaching and drying, the leather is impregnated by saturating it under the action of heat with stearin and paraffin, until it is fully saturated. After this treatment it is exposed to the action of a caustic soda bath of a strength of from 5° to 10° Bé., whereupon it is treated with sulphuric acid of 5° to 10° Bé., next again washed, then retanned and finally treated for a short time in a solution of metallic salts, such, for instance, as alum, aluminium sulphate and the like. The finishing is then done in the ordinary way by drying, pressing, rolling, etc.

The leather made in this way is extremely firm or solid and almost perfectly waterproof, but dry and clear and from its outside appearance cannot be differentiated from unimpregnated leather. It may be dyed and finished exactly like the latter and sized and polished; it does not slip when in use, and finally it exhibits all the properties which can be demanded from a heavy leather such as sole leather, driving belt leather, and saddlery leather.

A PROCESS OF WATERPROOFING LEATHER WITH RUBBER.

An interesting process of waterproofing leather according to the following directions is patented in Great Britain.

The leather is first subjected to any well-known fat-liquoring process which has the effect of not only softening it so

that it can be more conveniently worked, but also causes the pores which have contracted to expand. The hides after the fat-liquor treatment are secured to the drying frames from which they are removed when dry and then buffed upon the flesh side in order to raise the fiber. After this they are treated with a solution designed to kill the fats or oils, referred to as a clarifying solution, by being immersed in it or sprayed with it. Next they are placed in a hermetically closed vessel in which they remain for a suitable period, according to their weight and character; in the case of hides of average weight about forty-eight hours.

The clarifying solution to which the hide is first subjected may be composed of the following ingredients in about the proportions specified, which are suitable for chrome-tanned hides of average weight and sufficient in quantity to treat from fifteen to twenty hides: Powdered sulphur, 1 lb.; carbon bisulphide, 4 lbs. This mixture is allowed to stand for forty-eight hours with occasional stirring; it is then strained, and to the liquor residue is added a second mixture adapted to precipitate the undissolved sulphur and also "kill" or dissolve out fats.

The following mixture is suitable for this purpose: Sulphuric ether, 12 ozs.; benzol, 10 to 12 ozs.; coal tar naphtha, 10 ozs.; petroleum benzine, 6 ozs.; kerosene, 4 ozs.; rectified spirit of turpentine, 4 ozs. These quantities are those suitable for addition to 5 lbs. of the carbon bisulphide solution. When very light skins are being treated, the kerosene and turpentine are omitted. Two or three parts of the above combined mixture are taken and to it are added 5 gallons of benzine, the liquid thus formed being employed to treat the hides in the manner above stated. As it is desirable that only the smallest particles of sulphur be held in suspension in the liquid so that the pores of the hide will not become choked up, the liquid may be again strained. After this treatment the hides are removed and dried by heat, and when dry and while still warm are treated with a solution containing rubber.

It is convenient to have a stock solution of the rubber

which may be prepared by dissolving 1 lb. of Para rubber in from 1 to 2, or more, gallons of naphtha. In preparing the first bath from the stock solution take equal parts of the rubber solution and benzine, the hides being treated with the mixture. The hides while in the rubber solution are heated, and with this object in view the vessel may be jacketed so that steam, water or other means for heating may be employed and the temperature of the said vessel regulated. The temperature may range from 80° to 100° F., and the period of treatment extend from two to five days in each bath. The treatment, however, must be modified according to the nature, weight and origin of the hides.

The hides during treatment should be removed from time to time and worked by hand, or the liquor in the vessel may be agitated, or the hides kept moving in the vessel, or any other means employed so that the hand working may be dispensed with.

The leather is next subjected to a second treatment with rubber in conbination with a sulphuric solution. This rubber solution should be of a somewhat more viscid nature, that is to say, it should contain a greater quantity of rubber. For the second bath again dissolve 1 part of powdered sulphur in about 4 parts of carbon bisulphide and allow the solution to stand as before. To this is again added a mixture adapted to precipitate the undissolved sulphur and there is further added chloride of sulphur. A suitable mixture is as follows: 1 part powdered sulphur dissolved in 4 parts carbon bisulphide, 5 lbs.; sulphuric ether, 12 ozs.; benzol, 10 to 12 ozs.; coal tar naphtha, 10 ozs.; petroleum benzine, 6 ozs.; chloride of sulphur, 10 ozs. About 6 quarts of this are added to every 50 gallons of a rubber solution which should contain more rubber than the first bath, a suitable composition of such rubber solution being 4 parts of benzine to 5 parts of the stock rubber solution.

After the treatment last referred to, the hide is drummed with a final rubber solution in order to stuff it, and according to the weight of the hide the stuffing process occupies from

twelve to twenty-four hours. In the case of the final drumming, employ a rubber solution composed of 1 part stock solution to 2 parts benzine, and to every 10 gallons of such rubber solution add 4 pints of the chloride of sulphur solution just above described. The hides when taken from the drum should be placed upon a suitable surface and slicked off or scraped to remove the surface rubber, the final surplus rubber being removed by rubbing with a cloth dipped in benzine. The hide after the removal of surplus rubber is hung up and when it is partly dry, is rolled, which completes the treatment.

Another Process of Waterproofing Leather.—Skins and strings of musicial instruments are impregnated with collodion, gutta percha, India rubber or other similar gum in suitable solvents in order to render the said skins and strings less susceptible to atmospheric changes. In the process which will here be described, there is added to the rubber solution with which the leather is finally drummed, a solution of celluloid in acetone or other suitable solvent. The addition to the rubber solution is preferably effected after the drumming process has been in operation for some time. And in order to prevent the slipping of the leather upon a damp surface, gum juniper, ether, amber resin and benzol are added to the rubber solution.

The resins employed should be as free from impurities as possible, otherwise the impurities will stop up the pores of the leather so that the liquor cannot enter the same. At the same time it is desirable that one of the resins employed should possess a permanently sticky nature, which is found in gum juniper, and which sticky character is present even when the solution is in the leather. Amber resin is combined with the gum juniper for reasons of economy.

The best quality of benzol is the most efficient solvent, but as it is a costly ingredient, a lower grade of benzol or naphtha may be used in varying proportions.

In practice, assuming that from fifteen to twenty hides are being drummed, there is added, after the drumming has been in progress for some time, a solution composed of celluloid

dissolved in acetone. After this, additions at suitable intervals are made of gum juniper dissolved in ether (methyl), amber resin dissolved in benzol and about an equal quantity of naphtha or lower grade benzol.

The rubber solution is composed of 5 lbs. of fine hard Para rubber dissolved in 6 gallons of naphtha and 10 gallons of benzine. The exact quantities of the various materials used, however, depend upon the quality of the rubber and of the other substances, and also upon the quality and weight of the hides.

The celluloid solution, of which about 6 quarts are required, is composed of celluloid dissolved in acetone in the proportion of 9 ozs. celluloid to about 9 pints of solvent.

The amber resin solution, of which about 3 quarts are required, is composed of 3 lbs. amber resin dissolved in 60 ozs. of benzol and 60 ozs. of naphtha. Of the gum juniper solution $1\frac{1}{2}$ pints are employed, the said solution being composed of 16 ozs. of resin to 30 ozs. of ether.

In actual practice, the final drumming is started, and after the leather has been drummed for two or three hours, the solution of celluloid in acetone is added, and after a further interval of two hours, the solution of amber resin; after a further period of two or three hours the gum juniper solution is gradually added.

The treatment described adds considerably to the water and damp-resisting properties of the leather and the leather has a much better grip upon a damp or greasy surface than that not so treated.

BUTYRIC ACID IN CHROME TANNING.

During the processes that precede tanning everything should be done to insure the skins having soft grain and fine texture, coarseness and roughness being especially undesirable in chrome leather. One thing that in an experimental way has been found to produce soft-feeling leather is butyric acid used in drenching, pickling and tanning. The skins can be drenched or bated with any suitable deliming material, then

pickled with butyric acid, and, without the use of muriatic or sulphuric acid, tanned by a two-bath process. For each 100 lbs. of skins to be pickled use 15 gallons of water, 10 lbs. of salt and from 10 ozs. to 1 lb. of butyric acid.

The skins are drummed in this liquor thirty minutes, then allowed to drain several hours before they are placed in the first bath of the chrome process. Butyric acid may with good results be used together with bichromate of potash or soda in the first bath; it can also be safely employed for drenching the skins after liming, particularly sheepskins.

A method of using the acid in chroming the skins is as follows: After the goods have been drenched in any suitable manner and pickled with butyric acid, they are allowed to rest in the liquor an hour. The drum is then started with the same bath and to it is added a solution of 4 lbs. of bichromate of potash and 1 lb. of butyric acid in 10 gallons of water. After a drumming from one to two hours the skins are drained as usual and then passed into the second bath composed of hyposulphite of soda and acid. The result is well-tanned leather with a soft grain and an agreeable feel.

SECTION NINE.

Receipts, Formulas and Processes.—*Continued.*

NOTES ON THE MANUFACTURE AND APPLICATION OF FAT-LIQUORS.

From the scientific point of view there is a great deal still unknown in regard to the action on leather of those emulsions of oil and soap technically termed fat-liquors. While now used on many varieties of bark and combination-tanned leathers, the use of fat-liquors is a development of, and with the manufacture of, chrome leather. Indeed, it is no exaggeration to say that the success of the chrome leather industry was dependent upon the discovery and application of the fat-liquors, and even today the use of a correct fat-liquor is vitally necessary for the production of marketable leather.

To a considerable degree the formulas for various fat-liquors are among the most carefully guarded secrets of a leather manufacturer, yet in the main the composition and method of preparation of a good quality of fat-liquor has become well-known. Practically then a fat-liquor can be defined as an emulsion of oil and water, usually containing soap and frequently other emulsifying agents. Its purpose is to fill or nourish the leather and to keep it from drying hard or brittle. Just how it effects this result is not wholly understood. Some good authorities have stated that the chrome tannage is really a mixed mineral and oil tannage, and that the fat-liquor should be regarded as a tanning agent. There are reasons for and against this view. In the old days of bark-tanned leather, the use of oil in finishing or currying leather was certainly an essential part in the production of salable upper leather. Such oils as were used, however, were put in as oils or grease, i. e., the leather was stuffed, to use the technical

term. It was then never considered that the oil or grease acted as a tanning material, but rather as a lubricant and a waterproof filling and coating to preserve the leather.

It is presumable that Robert Foerderer, the inventor of Vici kid, the first merchantable chrome leather, was the real inventor of the emulsified fat-liquor, although the claim has never been put forward; yet according to all evidence, it was the use of the fat-liquor that made Vici leather far superior to the attempts of other leather manufacturers. When the knowledge concerning the use of emulsion of oil began to leak out, other manufacturers began to make good chrome leather.

Before going any further into the why and wherefore of fat-liquors, it will be perhaps well to consider a little their general constitution and preparation. An emulsion is a mixture of liquors which are mutually insoluble, but which are so mixed that fine particles of one are suspended in the other. The term is usually, although not necessarily, applied to mixtures of oil and water. Milk is often cited as the most perfect of emulsions. In order that an emulsion may be at all permanent, it is in general necessary that a third substance called an emulsifying agent be present. Such emulsifying agents act by increasing the viscosity of the one liquid in which the fine particles of the other liquid are suspended to such a degree that the tendency to separate into different layers is largely overcome. In the case of milk, the casein and milk albumen act as emulsifying agents. In the familiar examples of codliver-oil emulsions of the pharmacy, the emulsifying agent used is gum acacia or gum arabic. For the purpose of leather manufacture it has been found by experience that neither the casein of milk, or gum arabic, or indeed any other gum acts suitably as emulsifying agents in fat-liquors. Primarily they make trouble by perceptibly stiffening and harshening the leather, and then their power to increase viscosity diminishes rapidly with a slight increase in temperature. Soap has therefore become largely used as the emulsifying agent in the preparation of fat-liquors. Regarded

simply as an emulsifying agent, soap is not especially effective, but it has the extremely important advantage, i. e., provided the right kind of soap is used, that it does not injure the leather. To increase the efficiency of soap, two other emulsifying agents are used, eggyolk and sulphonated oils. Eggyolk is itself an emulsion, and the emulsifying agent in it is known as vitellin, an albumen considerably resembling casein. Presumably because the proportion of oil and albumen in the eggyolk to the water contained in it is greater than in milk, and therefore it can be used in relatively greater proportion, eggyolk is much more efficient in a fat-liquor than milk.

Sulphonated Oils.—The subject of sulphonated oils, sulphated oils or acid fat-liquors, as fat-liquors containing these treated oils are called, is a large one and can be only briefly considered here. The best known sulphonated oil is Turkey red oil. This is made by the action of sulphuric acid on castor oil. It is largely used in the textile industry, especially in the dyeing of Turkey reds, hence the name. Its manufacture really requires considerable care, and it is best prepared on a large scale in factories making a specialty of its production, but inasmuch as leather manufacturers using it have generally desired to keep that fact secret, they have endeavored to manufacture it for their own use rather than to purchase it from an experienced maker. Such manufacture is usually attempted with imperfect apparatus as well as inadequate knowledge of the subject. In the first place, castor oil is practically the only oil that can be sulphonated in the true sense. This is so because the principal fatty acid in castor oil is ricinoleic acid, an unsaturated acid. This statement does not mean that other oils than castor oil cannot be treated with sulphuric acid and some sort of a product obtained, nor should it be understood that it is impossible to sulphonate fatty acids other than ricinoleic acid, but under the conditions under which castor oil is sulphonated, it is impossible to substitute other oils and get an analogous product. For example, the fatty acids of linseed oil are very largely unsaturated, but

unless extraordinary precautions are taken to cool the mixture of acid and oil, the reaction is so violent that what is known as secondary reactions take place and the fatty acids are largely destroyed.

Rather than attempt to sulphonate linseed oil, which from its well-known drying nature, i. e., tendency to become resinous, does not recommend itself as a good leather lubricant, a much more common practice among tanners is to treat oils, for example, neatsfoot and tallow oils, whose fatty acids are principally acids of the oleic acid class, with sulphuric acid. Now it is possible to sulphonate oleic acid, but not under the conditions usually employed in the tannery. Oleic acid sulphonates only at a high temperature, and when an attempt to sulphonate one of the oils which consist largely of it is made, no sulphonation at all, or practically none, results, but the oil is simply broken up by hydrolysis and separates into its constituent parts, *viz.*, fatty acid and glycerine. Now, for some purposes it may be desirable to have as constituents in a fat-liquor a free fatty acid and glycerine, but these products do not perform the same function as a true sulphonated oil, that is, act as emulsifying agents.

Casein.—Casein has been employed as an emulsifying agent, but the fact that it is soluble only in alkaline solutions makes its use objectionable. Also the extreme liability of casein solutions to putrefy is a disadvantage, especially as the usual antiseptics precipitate it. Probably the most satisfactory preservative for casein solutions is white arsenic, only a very small quantity of it being needed, and the trace of arsenic that remains in the leather is so infinitesimal that no objection can be raised to its use. One part of arsenic to two thousand parts of fat-liquor is a proportion that has been used with success.

Eggyolk.—This, as has been stated, is generally used as a valuable constituent of fat-liquors. It is itself an emulsion in which an albumen similar to casein is the emulsifying agent. Probably one reason for the superiority of eggyolk to casein is, because in the case of the latter the natural emulsion

is broken up while the former is used in an unchanged state. There is sufficient excess of albumen in eggyolk over that required to emulsify the natural oil it contains, to make it suitable for use in fat-liquors and hold large proportions of other oils in a state of emulsion. It is for this purpose it is valuable in fat-liquors; unfortunately some dealers in the material, acquainted with this fact, add other oils to the eggyolk. These oils of themselves are not necessarily deleterious to the fat-liquor, but inasmuch as by their presence the emulsifying power of the eggyolk is reduced, they are rightly considered an adulteration. Still more reprehensible is the practice of sophisticating eggyolk with emulsions of oils and casein, which are colored by aniline dyes. An easy test for such adulterations is the addition of a small amount of ammonia to one portion of a suspected sample and a small quantity of acetic or muriatic acid to another. If the addition of either the ammonia or the acid produces a very decided color-change in the eggyolk, it indicates the presence of an aniline yellow, and presumably an adulterated product.

Potash Soaps.—Potash soaps are preferably used as the soap constituent of fat-liquors. The reason for this is that they are soft soaps, that is, have a lower melting point, than the hard soda soaps. The objection to the high melting point, or perhaps to express it another way, the low solidifying point of the soda soaps is that it causes white specks or soap crystals to form in the leather, which is one variety of the familiar spueing, a specially annoying defect in finished leather.

While all the potash soaps are softer than the corresponding soda soaps, that is those made from the same oils or fatty acids, one prepared from a hard solid fatty acid, will be nearly as hard as a soda soap made from a liquid fatty acid such as oleic acid. Also, if a soda soap is made from a liquid fatty acid and a large percentage of water allowed to remain in it, it will closely approximate the appearance of a potash or genuine soft soap. A simple drying test will, however, serve to distinguish the true from the false. In order to appear soft, a soda soap must contain a high percentage of water, and this water

will evaporate and the soap remain behind hard and dry, if a small sample of it is for a few hours exposed to gentle heat in a shallow dish placed on a radiator or uncovered steam pipe. Potash soaps, on the other hand, will never dry out hard unless made from a very hard fat.

Fig Soap.—A soap which has had much vogue for fat-liquor purposes is the so-called fig soap. It was originally a potash soap made from olive oil foots or the crudest residual oil which contains a considerable amount of unsaponifiable matter, largely phytosterol, and this gave to the soap the consistency similar to fig paste in which on long standing soap crystals formed which increased this semblance by giving the appearance of seeds. Much of the fig soap now offered is made from a mixture of olive oil foots, cotton-seed oil and tallow, and in appearance is much superior to that made exclusively from olive oil foots, as the tallow forms much harder soap crystals than occur in the original soap, and the cotton-seed oil is naturally lighter-colored than the "foots," the mixed soap being thus clearer as well as having a more seedy appearance.

For practical use a soap is probably better made in the old way, as the hard stearic acid soaps (from the tallow) will crystallize in the leather as well as in the soap and cause spueing.

The use of rosin oils must be especially warned against. These oils are obtained by distillation of rosin, and while they are saponified, the products so formed have but few of the properties of ordinary soaps having very little emulsifying power and are not usable in fat-liquors.

The free fatty acids of rosin oils are objectionable as they oxidize and become resinous or "gum." Some sulphonated rosin oils have been offered for fat-liquor purposes, but from theoretical considerations, there is no reason to suppose that they will have sufficient efficiency to replace castor-oil compounds. A final word in regard to fat-liquors is the question of alkalinity or acidity. The first fat-liquors were essentially alkaline, because of their large soap content; while the sulphonated oil compounds have an acid nature. If alkaline and acid fat-liquors are mixed, as frequently has been the

case, the possible good effects of either when used separately are nullified.

The effects on colors should be also considered, and it should specially be borne in mind that an acid fat-liquor has much less effect on colors than one that is alkaline or contains a considerable quantity of soap.

MATERIALS USED IN FINISHING LEATHER.

In the finishing of leather materials are used that are neither oils, dyes or mordants, and are classified as finishing materials, their function being to fill the pores and surface the leather. They may be divided into products of animal origin, such as blood and egg albumen, casein, gelatine, isinglass, etc., and of vegetable origin, among the latter being gums, as arabic, tragacanth and shellac, starches, dextrines, moss, etc. Some of these materials that are in common use will be briefly considered.

Blood.—Large quantities of bullock's blood are used in finishing leather, indeed, many seasoning liquors are nothing but logwood extract dissolved in warm water and then thickened with 5 to 10 per cent. blood. The best material to use is what is commonly known as defibrinated blood, which is blood that has been allowed to clot spontaneously by standing for a number of hours in a warm place, and from which the clot is then filtered. This defibrinated blood is practically a solution of blood albumen. The clot is albuminous but consists of the organized or cellular structure of the blood, i. e., the blood corpuscles. The coloring matter of the blood is in the red corpuscles and is carried down with them in the clot, while the filtered blood, if care is taken in its preparation, is a straw-colored fluid. In order to prevent putrefaction, a preventive should be added to the blood as soon as it is filtered, carbolic acid or phenol being most frequently used for this purpose. Nitrobenzol or oil of myrbane is also used and is fully as efficacious, and although slightly more costly, is to be recommended as it is much less poisonous than the phenol and has a pleasant instead of a disagreeable odor.

Blood Albumen.—This is made from the defibrinated blood by simple evaporation in vacuum pans. The evaporation must, however, be conducted with extreme care so that the temperature does not rise above 130° F., as above this temperature the albumen will begin to coagulate, and when once coagulated is valueless as a seasoning agent. When evaporated to a paste the blood is removed from the pans and placed on screens in a warm air drier. In this drier the temperature is even more important than in the pan and much albumen is destroyed by overheating. In this country, however, where the animal by-products like blood albumen are controlled by large packers, these preparations are made under scientific supervision, and there is much less damaged albumen offered in the United States than in England and on the Continent where any good-sized slaughter house may work up its by-products.

Egg Albumen.—This is prepared from the white of the egg, by far the largest proportion of the world's supply being manufactured in China from ducks' eggs, and some in Russia. The great advantage that egg albumen has over blood albumen is its absolute freedom from coloring matter or iron, which amounts to the same thing, as the red color of blood is due to iron. For this reason egg albumen is used in the seasoning of the best qualities of glazed colored leathers. Its cost is always high, five to eight times that of casein and two to three times that of blood albumen ; hence it can be used only sparingly and on the highest-priced goods.

Gelatine and Glue are both used to considerable extent in finishing of leather, and are also interesting to the tanner as they are, especially the latter, by-products of the tanning industry. While there has been more or less published on the manufacture of these products, the industry has not reached a high state of scientific development. This condition is not because of lack of chemical investigation, but because of the extreme difficulty of the subject. The present varieties of glue are classified as hide or skin glue, the purest form of which is gelatine, bone glue and fish glue, and to the latter

isinglass stands in the same relation that gelatine does to hide glue. All these varieties have a close chemical relation to each other, and are unquestionably complex compounds. Two principal constituents of glue have been separated, and are known as glutin and chondrin, the one being distinguished from the other by different behavior towards chemical reagents. While, for example, both are precipitated from their aqueous solution by alcohol, only chondrin is precipitated by acid, alum, lead acetate, etc. It also contains less nitrogen than gelatine and more sulphur and, in general, bears a closer resemblance to albumen. The glutin imparts the adhesive property to glue, while chondrin is perhaps more essentially the jelly-forming constituent. By treatment with caustic alkalies, by a sort of hydrolysis as it were, chondrim seems to be converted to a considerable extent into glutin.

Chondrin is found in greater portion in the bones, skin and cartilages of young animals, and glutin in the hides of older animals.

Gelatine, as has already been stated, is the purest form of skin glue, and is prepared almost wholly from the trimmings of calfskins, particularly the heads and feet, which are regular articles of commerce for this purpose. Curiously enough, these have to be dried first before they will make good gelatine, showing that a certain degree of dehydration is necessary to produce the glue-forming products. The first step in the manufacturing process is the washing of the glue stock. This is accomplished in the ordinary cylindrical washing machine, not greatly different from that used in laundries. The stock is then limed from ten to twelve days with frequent changes of the liming liquor. After liming, a treatment with sulphurous acid is given to remove the lime and also to bleach the stock. Then the stock is thoroughly washed and given according to the most approved processes, a bath of hydrogen peroxide to complete the bleaching and also to oxydize any residual sulphurous acid, the presence of even a mere trace of which is now forbidden by most pure food laws. Sometimes phosphoric acid is used in place of the hydrogen peroxide, its

action being simply that of replacing any sulphurous acid that may be chemically combined with the stock. The latter is then given a boiling with live steam, preferably at low pressure, which effects the conversion into gelatine which is then drawn off and allowed to gelatinize. The jelly is cut into slabs, placed on wire screens and dried by a dry, slightly warmed, air blast. When thoroughly dried it is ground in a disintegrator mill and packed ready for market.

Glue.—The preparation of glue from hides and skins does not differ materially, except in the selection of the stock, from that of gelatine, the treatments, however, being more rigorous, and less care is necessary in the manufacture. When bone glue is made, the fat is first extracted, preferably with a volatile solvent, and then the bones are treated with muriatic acid to dissolve the phosphate of lime, which constitutes their mineral matter. The stock thus obtained is after washing thoroughly, boiled to glue in the usual manner.

Isinglass is the purest form of fish glue and is obtained from the sounds or air bladders of fish. The best quality is made from the sounds of Russian sturgeon. The sounds are air dried, thoroughly washed and boiled to the glue stage. Ordinary fish glue is made from the scales, skins and other offal from fish. It is a particularly adhesive glue, but its odor renders it objectionable for many purposes. In the preparation of all glues, the essentials are the selection of the stock, and care in the manufacturiug processes, particularly the avoidance of putrefaction and overheating.

Casein is also known as milk albumen and lactarene, and, prepared in a crude way has been used for centuries as a finishing material on various sorts of upper leather. Without question much of the early Morocco and eastern leather was finished with a curd obtained from milk. With cow's milk, the separation of the curd from the whey and its utilization as an albuminous material, was in Scotland a hundred or more years ago, a considerable, if primitive, industry. In the analysis of cow's milk, a distinction is made between casein and milk albumen, and this distinction is recognized chem-

ically, although commercially casein is frequently known as milk albumen. The distinction is due to the fact that milk contains two kinds of albumen, the casein or insoluble albumen, which separates from the whey when it becomes sour, or when diluted acid is added to it, and the milk albumen proper, which very closely resembles blood albumen, and is only rendered insoluble by acidification and heat.

In commerce, the casein is the only product which is utilized. This is obtained as a by-product of the butter industry. The whole milk as it comes to the creamery is put through a centrifugal separator, in which the lighter cream containing the butter fats is very perfectly separated from the heavier skim milk. When casein is to be produced the skim milk must be acidified to separate it. There are three methods of doing this. The milk may be allowed to sour spontaneously in which case lactic acid is developed by the fermentation of the milk sugar, and this lactic acid precipitates the casein, or sulphuric acid or muriatic acid may be added to the milk.

For many purposes the casein precipitated by the lactic acid is the best product, but it has one very serious objection and that is its odor. When milk ferments, not only a lactic fermentation develops but also putrefactive bacteria, especially of the butyric acid class, are present, which attack the casein itself, the result being, even though in slight degree, very bad-smelling compounds, so that for many purposes casein made by this process is almost impossible to use.

Sulphuric acid precipitated casein is, on the whole, probably the best commercial product. It is troublesome to make, however, as the sulphuric acid swells up the casein so that it is extremely bulky, is difficult to wash, and must be pressed in powerful presses in order to reduce its bulk and remove the excess of water before drying. On the other hand, if muriatic acid is employed as a precipitant, the casein comes down granular and more compact, can be readily washed and requires no pressing. The resulting casein is, however, not so satisfactory, it being much less soluble in the alkaline mediums, and the yield is low. The difference in behavior of

sulphuric and muriatic acids is interesting to the leather chemist because it is analogous to the action observed with these acids in connection with the swelling of hides, wherein sulphuric acid has a pronounced plumping effect, while muriatic acid in certain dilutions has just the opposite effect and depletes the hide. When the casein is precipitated and washed, it is dried in a warm air blast, great care being taken that the temperature does not rise much over 100° F., otherwise the casein will become insoluble by overheating. The casein is marketed either in the form of coarse scales as it comes from the drier, or is ground to a coarse powder, this product being often mixed with borax or a mixture of borax and bicarbonate of soda, and sold as soluble casein. Since borax is much less expensive than casein it is more economical to buy the casein and dissolve it with the aid of borax, the average proportion used being 1 lb. of borax to 9 lbs. of casein. For most purposes equally good results can be obtained with 1 lb. of borax, 2 lbs. of bicarbonate of soda and 27 lbs. of casein. In the commercial soluble caseins the proportion of casein is often for obvious reasons considerably reduced. If, however, a casein requires more borax than stated to make it dissolve, it is because it has been overheated in drying.

Irish Moss.—The most widely used glutinous substance of vegetable origin in the finishing of leather is Irish moss, sometimes erroneously called Iceland moss. The true Iceland moss is a lichen that is found on exposed highlands, notably in Norway and Sweden, also in the Alps, and is used to a limited extent in pharmacy. Irish moss or carragee is found on all the rocky shores of Northern Europe, and is particularly abundant on the west and northwest coasts of Ireland. In America large quantities are gathered off the shores of Scituate, Massachusetts.

When fresh the plant varies in color from light yellowish green to bright purple and purplish brown, but after it is washed and dried in the sun, it becomes lighter-colored, of a yellowish or brownish-white shade. Viscous and fleshy when fresh, it dries to a semi-transparent, horny substance, the

branching form of the plant, though somewhat shrunken, being preserved. The preparation of Irish moss for the market is extremely crude, and it usually occurs in commerce carrying considerable quantities of sand and small shells. It is generally possible to purchase at a little above the lowest market price, moss which has been prepared with more care and is reasonably free from these impurities, and because of the quantities used, this course is often the truest economy. Large quantities are also sold in the ground form as a coarse powder. The objection to this form is the probability that the product is adulterated with corn starch.

Algin.—In England the algin is on a large scale extracted from seaweeds and sold in its purified state for purposes of leather dressing. The method of preparation is described by Lamb ("Leather Dressing," p. 277) as follows: "The dried weeds are first washed thoroughly to remove as much inorganic matter as possible and then dissolved to form a thick jelly in a boiling solution of caustic soda. It is assumed by this treatment that an alkaline salt, sodium alginate, is produced; from this salt, by the addition of acid, the algin, or alginic acid, is precipitated. The precipitated algin is then mixed with a fresh portion of alkaline salt to form a more nearly neutral alginate, and in this form is offered to the trade." English reports have been as a rule favorable to the product, but it has never been offered or used extensively in this country.

Algin is specially recommended for finishing skivers for hat leather; also for book-binding and furniture leathers. Its action is much more uniform than that of the raw moss, and its solution keeps better, and it is more adaptable for various purposes. The addition of a small quantity to dye solutions as a thickener in table coloring is advocated as giving results superior to those obtained from flaxseed and gelatine, which are usually employed. It can, however, be used only with acid dyes, since it precipitates the basic colors.

Shellac.—This is obtained from gum lac or simply lac. The gum lac is an exudation occurring on the small twigs or

branches of several varieties of East India trees. It is produced by the puncture, in the egg-laying operation of the female insect known as the *Coccus lacca*, an insect analogous to that from which cochineal is obtained. The gummy exudation following the puncture has the function of furnishing a protective covering for the eggs and providing food for the maggots. The female insect expires after laying eggs and is also enclosed by the gum. The best grades of lac are obtained by breaking off the twigs before the eggs are hatched. These twigs come into commerce as stick-lac. By immersion in boiling water the gum lac is melted from the twigs, and the bodies of the dead insects, the eggs, etc., are removed by straining. The melted lac is then spread out into the sheets by pouring it on a slowly revolving surface, these sheets broken into small pieces constituting shellac.

Button Lac is obtained by simply pouring the melted gum on a flat surface so that it solidifies in small disks. Shellac is soluble, as is well known, in alcohol, the solution being known as shellac varnish. The solubility of shellac in alcohol, however, decreases rapidly with decrease in strength of the latter; care should therefore be taken, if a tanner or leather finisher desires to "cut" his own shellac, that he use at least a full 95-percent alcohol. Also that he keeps his alcohol and varnish well sealed, as high-strength alcohol rapidly dilutes by the absorption of moisture from the atmosphere. In case the alcohol has become diluted it may be freed from water by shaking it up with fresh quicklime, and then decanting the clear liquid. Shellac is soluble in aqueous solutions of the alkalies, and also in a solution of borax, and for many purposes these solutions, especially that in borax, can replace with economy the alcoholic varnishes, that is, for those purposes where shellac is used for its adhesive or filling properties.

Pyroxylin.—Collodion, soluble cotton, banana liquid, etc., are names given to the solution of nitrated cellulose in various solvents. Nitrated or nitro-cellulose was first known in its highest state of nitration as gun-cotton, a high explosive, which is chemically a combination with the cellulose molecule with

three nitric acid radicals. This product is obtained by immersing thoroughly dried and purified cotton fiber in a mixture of high-strength nitric and sulphuric acids. Later on it was discovered that by immersing cotton in a mixture of somewhat less concentrated acids and at a higher temperature, a much less explosive compound was obtained. This compound, which is composed of about equal quantities of the tetra and tri-nitro celluloses, has the added advantage of being soluble in mixtures of ethers and alcohol, acetone and amyl acetate, gun-cotton itself being insoluble or soluble with difficulty in them. On evaporation of the solvent, a very elastic coating or varnish is left behind, the nature of this varnish depending very largely on the solvent which has been employed. The amyl acetate leaves the toughest and most elastic varnish and as such is largely used in the finishing of enameled and patent leathers. Because of its characteristic odor the amyl acetate solution is frequently called banana liquid. On account of the high cost of the amyl acetate, however, the solutions are often diluted with considerable quantities of acetone. Amyl acetate is obtained by the action of glacial acetic acid on amyl alcohol in the presence of sulphuric acid or potassium bisulphate.

The amyl alcohol is the chief constituent of fusel oil, a by-product in the manufacture of ethyl or grain alcohol, the largest quantities being obtained by the fermentation of a mash made from potatoes. Besides the use of these cellulose solutions for patent-leather manufacture, their employment in making a cement for joining the laps of chrome-tanned belt leather is of importance to tanners. For this purpose a highly concentrated solution in acetone is usually used, and the best cements contain also ½ to 1 per cent of red oil, which seems to have the effect of making the joint less brittle. Indeed, it is this small percentage of oil which has been the secret component of many of the commercial cements, and the ignorance of its presence prevented the belt manufacturers from successfully making their own cement.

THE USE OF FORMALDEHYDE IN THE TANNERY.

Preservation of Skins.—The antiseptic and germicidal action of formaldehyde has long been known in medicine and found of practical use, and its application for the preservation or disinfection of raw skins is therefore only natural. With its aid skins which have already undergone putrefaction may be sterilized, as well as such as it is feared may decompose during interruption of the usual process. To effect this, take for each 100 parts of the soak water, 2 parts of forty per cent. formaldehyde, and use this solution for six to eight days, when it should be strengthened by the addition of a further 2 parts of formaldehyde. Dried skins should be merely soaked for ten minutes in a solution of formaldehyde of 4 per cent. strength, after which they should be laid in piles for twelve hours and finally dried in the air.

In 1902, Roberts, of Buenos Aires, patented a process by which skins were subjected to the action of antiseptic gas, that is formaldehyde, for a time in order to preserve them. The Conservadore Mercantile Company of the town, according to this patent, submitted skins after flaying and before salting, to the action of formaldehyde vapors in closed chambers. This destroyed the putrefactive elements which were likely to be present in the skins and sterilized them for a certain time; finally the skins were salted and dried out.

Salting by itself does not sterilize skins in an absolutely permanent manner; it can only retard and diminish the development and the activity of the putrefactive organisms, the damage known as salt stains being probably caused by the micro-organisms which resist the action of salt, and it may be presumed that a treatment with formaldehyde would in a large measure reduce this form of damage. Also for skins which are preserved by means of drying, formaldehyde may be of excellent service, the goods not being exposed to the risk of decomposition setting in during drying. Moreover, the pungent odor of the formaldehyde repels flies and other insects which, under other circumstances are attracted to the skins during the process of drying, and thus the presence of

larvae in the goods is very likely prevented. Finally, it is possible by this means to disinfect the skins from carrying disease germs, especially from places which are often subject to this sort of danger. Complete disinfection by means of formaldehyde entails a very strong action, and this causes several difficulties in the work of soaking, liming, etc., which are nevertheless surmountable. In any case, it is only recommended to employ this process for skins which have undergone slight putrefaction, and for those in which mere salting would not suffice for perfect preservation. The strength of the solution should never exceed 5 per cent., for otherwise the skin substance will be greatly hardened. If the skins are to be salted, they should not be treated, previous to the salting, with a solution of formaldehyde, because they would absorb too much water, for the removal of which an excessive quantity of salt would be required. It is therefore necessary in this case to use formaldehyde in the gaseous form and not as a solution.

Soaking and Liming.—It is now to be indicated how skins preserved by means of formaldehyde should be treated in soaking and in liming. For skins partially disinfected by means of formaldehyde, this does not present any great difficulty, especially when the skins have been salted, for in such skins the salt has penetrated throughout so that they are not hardened at all. For dried skins treated previously with formaldehyde, it is necessary to add to the soak water and also to the lime liquors, some activating substance; in soaking, formic acid or sulphurous acid, and in lime liquors sodium sulphide. Naturally this method of working is not without disadvantage as regards the quality of the glue stock, for it is well known that one cannot obtain as good a quality of such stock, with limes reinforced with sulphide as with straight lime liquors. But of course, the main thing for the tanner is to obtain good leather, and although the value of the glue stock is not negligible, it is not the principal thing to consider.

Fixing the Swelling in Vegetable Tanning.—When formalde-

hyde was first introduced into commerce, the opinion was held that it swelled the pelt, and this was even pointed out in the circular of one of the principal firms selling this product; but it was soon perceived that the swelling was confused with the mere fixing of already acquired swelling. Certainly formaldehyde, on account of the free formic acid which it contains, always presents a certain acid reaction, but it does not swell the skins in the same sense that alkalies and acids do; on the contrary, when it has hardened the albuminous substances, it rather prevents any further swelling. If the skin is swollen beforehand, the formaldehyde will fix this swelling and will maintain the state of firmness thus obtained. The pores of the swollen skin remain open and the tanning substance penetrates much more rapidly into the skin tissue; consequently tanning can be carried out much more quickly and a particularly firm leather is obtained. As firmness is especially desired in sole leather, it is natural that attention has been turned to the use of formaldehyde in this process. Prof. Eitner, the German leather chemist, has given practical hints on this point. In speaking especially of the tannage with pine bark as used in Bohemia, where tanning is for coloring purposes commenced in three acid liquor pits; in which the desired swelling is produced, he recommended to follow the last of these swelling liquors by a treatment in very weak formaldehyde solution (2 parts formaldehyde to 1000 parts water) for twenty-four hours; finally removing the skins and tanning them. The tannage for skins thus treated can be effected by means of extract liquors, the result being a leather of the same firmness as that of Bohemia tanned entirely with pine bark. It is known in a general way that skin swollen in acid liquors, if placed immediately in fairly strong extract liquors, falls and loses the swelling. If, on the other hand, the goods are treated with a solution of formaldehyde after swelling, they can be placed directly into oak or chestnut extract liquors without running the risk of losing the swelling. These extract liquors form a transition between the early liquors and the stronger tannage of layaways.

The formaldehyde bath might be used several times. For the first, take for each 1000 parts of water 2 parts of 40 per cent. formaldehyde; for the following lots strengthen up with 1 to 1¼ parts. The skins remain in this bath for twenty-four hours at least, even twice this length of time is not too long for heavy hides. It is not advisable to use a bath stronger than the one above indicated, otherwise a spongy leather, and one in which the section is fibrous, is obtained, the grain also being swollen up and brittle. The foregoing matter is taken from an article by J. Jettmar in "Der Gerber" and republished in the "Shoe and Leather Reporter". For the following information we are also indebted to the latter paper.

In 1894, a firm of chemical manufacturers published in the technical press the results of experiments of tanning by means of formaldehyde. In 1897, Miller took out a patent on this line, and in the same year in "Der Gerber" Eitner described the results he had obtained in the tanning of skins by means of formaldehyde. Finally in 1898, Payne and Pullman took out a patent in several countries for the production of leather by means of a mixture of formaldehyde and alkaline substances, such as soda, lime, etc.

The following is an outline of their process: 400 parts of skins, after having been treated in the beamhouse in the ordinary way, are scudded and placed in a drum together with 500 parts of water at 38° C., (100.4° F.) Then is added, while the drum is turning, the tanning liquor composed of 5¼ parts of formaldehyde (this is 14 parts of commercial 40 per cent. formaldehyde), with 25 parts of calcined soda dissolved in about 50 parts of water. The drum is turned, and 5 parts of this liquor are added for a quarter of an hour. Light skins are tanned completely in three to six hours; heavy skins require from twelve to forty-eight hours. The temperature in the interior of the drum is then raised to 48° C., (118.4° F.) and the skins are treated with a solution containing 16 parts of sulphate of ammonia in approximately 500 parts of water at 45° to 50° C. (115° to 122° F). The skins are then taken

out, nourished with a mixture of 10 parts of soft soap and 10 parts of salt in about 350 parts of water. They are tanned in this liquor for three to six hours, then washed, dried and finished.

Some time after the Payne and Pullman patent, a French chemist, Combret, took out a patent for formaldehyde tannage, this time with the addition of acid. According to this process the skins are introduced into a bath containing formaldehyde and a certain quantity of free acid. As the tannage proceeds, successive additions of formaldehyde are made while the proportion of acid is maintained at the same strength as at the beginning. The relative proportion of formaldehyde to acid should not exceed 25 per cent. to 1 per cent. or in the other direction 1 per cent. to 25 per cent. This point of the patent is absurd, for in a bath containing 25 per cent. of formaldehyde or even 25 per cent. of acid no skin could exist.

In 1899, Eitner published a process of tanning with formaldehyde which was really practicable.

The Eitner Process. — According to Eitner's instructions sheepskins in the pelt form, after the usual beamhouse work, are treated for 24 hours in a liquor made from $\frac{1}{2}$ part commercial formaldehyde with 100 parts of water. On coming from this bath, the skins present an acid reaction, and they must be neutralized with a weak alkaline solution such as of carbonate of soda, borax, phosphate of soda, or better still, with one of a mixture of ammonium sulphate and carbonate of soda. Finally the skins are washed in clear water for forty minutes and drained. They are then fat-liquored with a fat-liquor made, for example, with 100 parts of neatsfoot oil, 25 parts of carbonate of soda and 500 parts of water, they being turned in this liquor one hour.

A product is thus obtained which is very supple and closely resembles an alum-tanned leather, it being of the nature of ordinary alum leather rather than of the glazed variety, the fullness of which it does not possess. Nevertheless, the grain is fuller and more brilliant than simple alum-tanned leather. If the flesh is passed over an emery wheel it very much resembles the velvety appearance of chamois leather.

If to the soap fat-liquor a little moellon of first quality is added, skins of a yellow color and extremely supple are obtained, which can be bleached the same as chamois leather. Neatsfoot oil and cod oil produce white skins. For a sheepskin of average weight 60 to 70 grammes (2.11 to 2.46 ozs.) of grease are necessary. With this quantity the skin is very supple and preserves its dry feel.

Finishing consists of smoothing, staking, dyeing as for ordinary chamois leather. If the skins are to be dyed they are treated like chamois rather than like tawed leather. Formaldehyde leather may also be treated like mocha leather, the grain which is buffed by means of emery or carborundum. In carrying out this work carefully a surface is obtained which is not a grain and which has the characteristic touch of velvet. In formaldehyde tannage the grain of the skins has always a slightly hard appearance, but when buffed off as described, this harshness is completely removed and a very fine leather is obtained.

Preparing the Skins.—With regard to the preparation of the skins themselves, this may be accomplished in two ways. In the first method, the skins after having been well scudded and bated, are placed in a ½ per cent. solution of formaldehyde and left for twelve hours, when they are neutralized, washed, and fat-liquored with a mixture of 2 parts of neatsfoot oil and 1 part of good moellon. They are then dried and fluffed on carborundum to give them a velvety and regular surface.

In the second method, the skins are first treated in the bate and afterwards immersed in the ½ per cent. solution of formaldehyde, but only for one or two hours, and after this, are tawed in the ordinary fashion for glazed skins, the finishing processes being the same. In dyeing the goods obtained by the first of these two methods, the processes commonly employed for chamois leather may be adopted in which the skins receive, after dyeing, a little fat-liquoring in the form of a small quantity of moellon. In this way skins are obtained that are useful for belts, lithographic rollers, etc.

Sheepskin Tannage.—The formaldehyde tannage of sheep-

skins can also be carried out as follows: For each 100 parts of pelt dissolve 1 part of formaldehyde, i. e., about 2½ parts of commercial formaldehyde in a convenient quantity of water, so that the operation can be carried out either in a paddle or a tub. The skins are left for 24 hours in a paddle, or 48 hours by suspension, then withdrawn, neutralized, washed and fat-liquored, the fat-liquor consisting of 3 parts of soft soap in 60 parts of water. Skins are thus obtained which are very similar to alum-tanned goods; they have a white section, and present a very fine grain, but stretch a little less than glazed skins.

If the goods are desired slightly yellow, similar to chamois skins, instead of fat-liquoring with soap, moellon should be used, which also gives to the skins the characteristic odor of cod oil.

When skins are being tanned with the grain removed, a formaldehyde tannage can be carried out much more easily, because in this case the grain, which is the most compact part of the skin, cannot resist the penetration of formaldehyde, and a 1 per cent. solution may be used. This quantity is added in two portions, and fat-liquoring is done with soft soap. This sort of leather can be very satisfactorily used for fancy belts, pocket-books, lithographic rollers, morocco leather manufacture and other fancy leather articles.

Besides to sheepskins, formaldehyde tannage can be successfully applied to other skins, such as calfskins, kips, etc.

Tannage for Kips.—The hides are limed and fleshed and passed through the usual beamhouse process, then washed in lukewarm water and tanned. For this a 1 per cent. solution of formaldehyde is made, that is, 2½ parts of commercial formaldehyde, in 100 parts of water. This solution is placed in either a pit or a paddle, and the skins are placed in it. If a pit is used care must be taken to handle the skins twice the first day and once the remaining days. At the end of five days half as much formaldehyde is added, and the skins are left for another seven to eight days, until they are completely tanned.

Tannage in a paddle is much more rapid than by suspension in pits. In the paddle tannage the skins are turned for one hour, allowed to rest for two hours, and so on alternately. At the end of five days the tannage is complete. As it is rather difficult by mere inspection of the skins to tell if they are completely tanned, it is necessary to control the tannage exactly by cutting pieces from the skins and drying them and noting if they stake out properly. The tannage is continued until this result is obtained. The skins are then removed, washed, neutralized, fat-liquored, dried, staked and finished. A supple, durable leather that is suitable for many purposes is in this manner obtained.

Another Process of Formaldehyde Tanning.—A fine, white leather is made by tanning hides and skins by the following process: The skins, after being bated and delimed, are treated with a solution of soda, preferably in a drum, and after the soda has been absorbed, a second bath is given consisting of a solution of formaldehyde, which is the real tanning agent and becomes fixed on the fibers of the skin. The leather is then fat-liquored, dried and finally buffed on the grain either by hand or by means of an emery or carborundum wheel, sufficient surface being given to raise a good nap. The leather finishes white and clean, and, owing to the nature of the tannage, the fibers are practically unchanged from a physical point of view, and thus retain to a very large extent their natural toughness. Another advantage over bleached leather is the fact that the leather is white throughout. The tannage is due to dehydration of the skins treated, i. e., the latter have, owing to the action of the chemicals employed, yielded up their moisture, while simultaneously the soda and formaldehyde have been absorbed and deposited within and around the fibers.

THE SOAKING OF SHEEP SKINS.

In the soaking of sheepskins previous to the removal of the wool, the tanner or the wool-puller has not only to consider how the skin can be best brought back to its natural soft

condition ; but it is also necessary for him to take into account the effect the method of soaking he adopts may have upon the quality of the wool, since it may be greatly depreciated in value by the use of wrong materials to aid the softening of dry sheepskins. In the case of skins received direct from the butcher, all that is required before the depilatory paint is applied, is to remove adhering dirt and blood by simply washing or soaking in water. Simple treatment in this way for a short time has no effect whatever upon the wool, but prolonged soaking may remove much of its peculiar natural fat, which should be retained, as otherwise the wool loses weight, and felting is liable to the take place, the luster of the wool being also diminished. Very hard water has an injurious effect upon the wool, insoluble calcium and magnesium soaps being formed with the fatty matter, so that the wool becomes coarse and difficult to dye.

For fresh skins the method recommended is to shake them free from adhering salt and then place them in fresh soft water to remove salt, blood, dirt, etc. They may then, if necessary, be transferred to fresh water for a few hours, after removing any clotted dirt and blood by beating or breaking over the beam. They are then drained and treated for the removal of the wool.

In the soaking of dry pelts something must be used to shorten the time required for bringing the skins back to the original soft condition. Of the alkalies that are commonly employed in soaking hair skins very few can be used on sheepskins, because of their injurious effect upon the wool. The wool fats are saponified by the alkalies and removed, leaving the wool brittle and less elastic and also injured as regards luster. Caustic soda and sodium sulphide will in a fairly weak solution completely dissolve the wool in a few minutes, and therefore cannot be used as softening agents ; neither can caustic potash and washing soda be employed. Ammonium carbonate and borax are the alkalies which have the least effect upon wool. If ammonium carbonate is used, the skins when placed in lime will become impregnated with calcium

carbonate (lime blast) unless the ammonium carbonate is first entirely removed by washing.

Borax may be employed in weak solutions, using 1½ lbs. to 100 gallons of water; but in stronger solution it too tends to dissolve the natural grease of the wool. It is not advisable to use acids in the soaks, because of their swelling action on the skin. Sulphurous and formic acids may be employed in extremely dilute solutions. The latter is to be given the preference. These acids are more or less dangerous, however, in the hands of careless and incompetent workmen. Acids are therefore not generally recommendable because of their action on the pelt.

Of the various soaking agents that might be used, sodium bisulphite has been found to give the best results, without injury to either skin or wool. This substance, which is best used in the solid form, is only very weakly acid so that there is no danger of swelling the pelt except in comparatively strong solutions. It is inexpensive, and only a small quantity of it is required for effective soaking. The wool is improved in color by the bleaching action of the sulphur dioxide present, and its quality, so far as strength, luster and elasticity are concerned, is in no way impaired. Sodium bisulphite also acts as an antiseptic, preventing the growth of micro-organisms which would produce decomposition of the skin with its consequent loss of skin substance.

According to the Tanner's Year Book, the strength of bisulphite solution that has been found to give the best result in the soaking of sheepskins is 1 lb. of commercial sodium bisulphite per 100 gallons of water. The dry skins are placed in this solution and allowed to remain in the same until they are soft enough for breaking over the beam. After breaking, they are transferred to fresh water to complete the softening, and they are then treated in the usual way. Very hard skins may be given a second treatment in the solution of sodium bisulphite.

Although bisulphite has an antiseptic action, the subsequent removal of the wool is not prevented. Whatever disadvan-

tages it possesses may be easily overcome. If any bisulphite solution remains in the skin after soaking, calcium sulphite, which is practically insoluble, will be formed in the skin when placed into lime, this, however, being removed if the goods are acid-delimed. In the experiments that have been carried out no defects were observed in the finished leather due to this condition. If the skins are placed in fresh water after breaking from the bisulphite solution, very little bisulphite, if any, will remain in them when they go into lime.

THE INDIAN METHOD OF TANNING BUCKSKINS.

The North American Indians have for ages dressed deerskins into leather, and the leather made by them is renowned for toughness and durability. A description of their method of dressing the skins may be of interest to some of the readers of this book. According to John Motheral in the "Leather Manufacturer," the skins are dressed in the following manner: The skin is fleshed and every bit of flesh and membrane is removed. It is then soaked in water to swell it and free it from blood, when it is ready for graining, which is done with a case-knife or a butcher's knife on a beam, having a diameter of six or eight inches. This way of removing the hair and the grain makes Indian-dressed buckskin of the highest class.

Another way of preparing the skin for graining is, after the skin has been fleshed and soaked, to handle it in a weak lye for two or three days, and then to grain it. But this does not yield a product equal in toughness to that by the former method. The skin being grained, it is ready for the tanning or tawing process, which is done with the brains of the deer or those of cattle, horses, hogs, etc.

To prepare the brains, take a piece of loosely woven factory cotton eight inches square, place the brains of an animal on the center of the cloth, gather the edges of the cloth into the hand and lift it up from the table, and tie a string around the cloth two inches above the brains. Now boil the brains in 1 gallon of soft water for an hour, then remove the kettle from the fire, and pour the contents into a clean pail and let it

stand until it cools sufficiently to bear the hand in it. The temperature having fallen to this point, take hold of the part of the cloth containing the brains and rub it between the hands, most of the time under water, till all the brains are forced through the cloth. This done, place the skin in the solution and work it with the hands. First knead it thoroughly, then stretch it every way. Repeat the kneading and stretching at intervals of ten minutes for an hour, then let the skin remain in the liquor two hours, when it is kneaded and stretched once more and allowed to remain another hour; then lifted out of the liquor and hung up to dry out two-thirds.

In cold weather the skin is allowed to remain in the liquor over night for it will not suffer in substance so quickly as in hot weather.

The skin having dried two-thirds, it is taken down and stretched every way; the white man would work it on a knee stake, then hang it up to dry further. The stretching is repeated at intervals until the skin is dry. The stretching and drying being completed, the skin is folded into a small compass, wrapped in cloth or in a finished skin to exclude the air, and allowed to remain two weeks or longer to season, when it is ready for the smoking process. Smoking the skin colors and retans it, the retanning bringing it to a state in which it may be washed with soap, yet dry soft. The smoking is done with a slow fire made of decayed wood, and is continued until the skin takes on the color desired, the color ranging from a light yellow to a dark yellowish-brown.

The Indian woman digs a small fire-place on the side of a knoll, then a small square trench connecting with, and leading away several feet, from the higher side of the fire-place, and over the end of the trench she places a barrel with both ends out, and then covers the trench from the fire-place to the barrel. Next, the wind being favorable, she starts a fire of decayed wood. The draft carries the smoke along the trench into the barrel, and the skin being stretched every way on the end of the barrel, the smoke penetrates it. When it has taken on the color desired, the skin is turned the other side

down and worked similarly till it too is colored the desired shade, which completes the smoking process. The skin is now hung up to cool and set; it is then folded into a small compass and left several days, when it is ready for washing.

The white man who undertakes to dress deerskins in Indian fashion need not follow the Indian way of smoking skins. Indeed, if he does, the chances are that he will not turn out as nice a piece of work as the Indian. The way for him to follow is to smoke the skins in a smoke-house such as is used for curing meat. In such a house the skins should not be hung up by the hind shanks nor by the head, for if they are, they will not be of a uniform color throughout. They should be tacked tightly to frames so that the smoke has free access to both sides of them. The skin being ready for washing, scour it thoroughly in lukewarm water, using plenty of soap, then rinse lightly in lukewarm water. This done, hang it, up without wringing, by the hind shanks to dry completely. Let it remain in the crust or dry state for a week, then immerse it in water three seconds, lift it out, give it a shake and fold it tightly and cover it for half a day or over night, when it will be found ready to be worked with the hand, stretched every way and then hung-up to dry out partly. Repeat the stretching and hanging up at intervals until the skin has dried completely, which finishes the work and leaves the skin soft and pliable.

NOTES ON GLOVE LEATHERS.

The modern glove-leather manufacturer has to deal with all kinds of skins, but chiefly with goatskins and sheepskins. Owing to the scarcity of raw skins, he is not able to pick and choose as much as he formerly did. Cape sheepskins form the glove-leather dresser's main supply and are now in general demand by tanners and leather dressers for a great variety of purposes, including boot and shoe uppers and bag work. The following information relative to glove-leather dressing is taken from an article in "The Leather Trades Review."

"The bulk of the skins is received in the dry salted state,

and a two day's soaking generally brings them to a condition in which they can be handled. Some goods require further treatment, however, and for this a drum must be used, the skins being placed in it without water after soaking and well drummed for some hours. They are now fit to be worked over the beam in order to remove fat, adhering dirt, etc., after which they are again thrown into clear water for another day, when they are ready to be painted. Either sulphide of sodium or red arsenic may be used with the lime, but for this class of leather the use of arsenic is increasing owing to the fineness of grain that results from its use.

"For painting fifty dozen average skins, 6 bushels of lime and 45 lbs. of red arsenic are required. In preparing this mixture, care must be taken to get a perfect reaction of the lime and arsenic. This is best obtained by first thoroughly mixing the two together and breaking the lime into small lumps. The mixture should then be carefully and thoroughly slaked with water and made into a pastelike mixture that can be painted upon the skins in the usual manner.

"The skins are spread out on the flour or upon a table and the mixture is applied with a mop to the flesh side. As each skin is painted it is folded over flesh to flesh, and placed in a pile and left until the next day. When the painting is done in the afternoon the skins are ready for pulling the next morning. Before being pulled they are washed and then placed upon the beam to remove the wool, which is generally sorted into four grades. The next process is liming, and the duration of this process varies according to the skins under treatment from seven days to two or three weeks. The old one-pit method still obtains in many tanneries and is carried out as follows: The pit is started with 5 bushels of lime, and the pelts remain in the same for two days when they are withdrawn, and the liquor is strengthened by the addition of 2 bushels of lime. In this liquor the skins are left for a week, then withdrawn and a final addition of 3 bushels of lime is made to the liquor. The goods remain one or two weeks longer as they may require.

"The amount of lime given above is sufficient for fifty to sixty dozen cape sheepskins, but much latitude must be allowed as so much depends upon local conditions, the water, the season of the year and the condition of the goods.

"During liming the skins are several times drawn, and when the process is completed, they are drained and allowed to soak in clean water for a day or two. The addition of a pailful or two of lime to the water is recommended. When the liming is completed the skins are trimmed and fleshed and left in water containing a little lime, after which they are passed through water to which some lactic acid has been added to accomplish a slight deliming.

"Bating or puering is carried out in a paddle about three-quarters full of water at 95° F. The bath may be composed of a solution of dog excrement, which gives great softness and silkiness to the leather. The length of time necessary to bring the skins down is two to three hours. When this has been accomplished, the skins are worked over on the beam, washed in warm water, and then horsed up to drain. The use of oropon for deliming the skins gives very good results and has everything to recommend it from a sanitary point of view.

"The next process of drenching requires a considerable amount of care to insure turning out a good article. For glove leather the bran drench is suitable. A large pailful of bran should be scalded and allowed to stand for a short time. As the goods are placed in the tub or paddle they should be well sprinkled with the bran and covered up to remain all night. They will begin to work after twelve hours, and should be turned over frequently to insure thorough working. If this is not done they are liable to get the drench into them and the grain will be seriously damaged. The temperature at which this operation should be carried out ranges from 85° to 90°F. The goods should be allowed to rise four times; then be worked on the beam, after which they are ready to be dressed into leather.

"The dressing (tawing) liquor for twenty dozen skins should

be made up as follows: 18 lbs. of alum and 20 lbs. of salt are dissolved together in boiling water. Then 6 quarts of egg-yolk and 20 lbs. of flour are mixed together and placed in the drum together with about 20 gallons of warm water and the drum is set in motion to insure thorough mixing. When well mixed, run in the alum and salt and let the drum run five minutes longer before putting in the goods. After these are in they should be drummed for an hour or two, and preferably allowed to remain in the liquor for a day or even longer before they are taken out and dried. This should produce a nice, white, well-fed leather. After drying, it should be allowed to lie a few days, next moistened and staked and dried, and then allowed to remain unfinished for some time to fully mature."

There are other methods of dressing leather for gloves, viz., chrome tanning, formaldehyde dressing, and oil or chamois dressing.

A very good glove leather, especially for heavy gloves, is made by the chrome process, sheepskins, calfskins and horse hides being used for this purpose. The goods, after drenching, are pickled with sulphuric acid and salt. They are then tanned by either the one-bath or the two-bath method according to the directions given for sheepskins, and then neutralized, washed and shaved.

There is also a method of retanning alum leather with chrome that gives excellent results. In this case the goods are wetted back and drummed in a solution of sulphate of alumina and salt, 3 lbs. of alumina and 6 lbs. of salt being required for 100 lbs. of leather. The materials are dissolved in 2 or 3 gallons of water and the solution is made up to 8 gallons. This is placed in the drum together with the goods and the drum is run one hour. The chroming follows immediately after, or if necessary or more convenient, the skins can be dried and chromed later on. A chrome liquor made of chrome alum and soda may be used, or one of the regular one-bath solutions that are procurable. When fully chrome-tanned the skins are neutralized, washed, shaved, colored and fat-liquored.

In the dressing of alum-tawed leather, a necessary preliminary before dyeing is the sorting of the goods for grain work and for flesh work, commonly called de-grains or suedes.

The first step in the actual process of dyeing is the preparation of the goods, which consists practically of removing the dressing, and it seems somewhat of an anomaly that this must be done before the goods can be dyed. It used to be the practice to wash back until the whole of the dressing was removed, but this custom has fallen off somewhat since the introduction of wood-dye extracts in crystal form. These crystals are actual extracts from the dyewoods and produce nice, clear coloring. They are also very convenient in use, and shades and patterns can be easily matched by simply varying the quantities of the different crystals. Moreover, they are always ready for use, being readily soluble in boiling water.

Owing to the penetrating powers of these extracts, a prolonged washing of the goods is not necessary. It is usual to wash for one hour, using three waters at lukewarm temperature, and adding to the second bath 2 to 3 per cent. of carbonate of ammonia.

Another way of washing back before dyeing is carried out as above described, but instead of using ammonia, a mixture of 7 ozs. soda crystals, 7 ozs. ammonia and ½ oz. bicarbonate of potash for every dozen skins is used, the skins being washed in lukewarm water to which this solution has been added. Much depends upon the age and condition of the goods as regards the actual amount of washing necessary, hard and long-tanned goods very naturally requiring more thorough washing than goods that are freshly dressed and are soft and clean.

The polygonal drum is the most suitable one for dyeing glove leather, as the more tumbling the skins receive the better the finished product will be. The most convenient size tumbler is one that carries a comparatively small quantity of leather, which insures uniform coloring.

The instructions which follow indicate the necessary mat-

erial and procedure for obtaining a nice shade of tan upon Cape grain skins, the quantities being for 100 lbs. of leather. The first bath should be one to which a solution of 1½ per cent. of bichromate of potash has been added to the water in the drum, and the skins are drummed in this solution for twenty minutes. They should then be taken out, and after the bath has been run off, placed in a new bath consisting of 8 to 12 lbs. of gambier dissolved and prepared with sufficient water. Thirty minutes should be allowed for this bath, during which the skins will have taken on a nice yellow shade. The following amounts of wood-dye crystals are next dissolved in 4 gallons of boiling water and the solution is allowed to cool: 1½ lbs. Cuba wood, ½ lb. fustic, ½ lb. Brazil wood, and ½ oz. logwood. It is advisable to strain these solutions before using them. A part of this solution should at intervals of a few minutes be run into the tumbler containing the gambier until the whole is run in. The goods should be examined occasionally to see if the shade is right.

About an hour should be given for the dyeing operation, which is carried out at a temperature of 80° F. Developing and fixing the color follows, and this is best accomplished with titanium-potassium oxalate, a few ounces of it being sufficient to darken the shade and fix the color. Allowance for darkening must be made in the dyeing. Futhermore, darkening can be carried out by adding a small quantity of bichromate of potash or by using some basic aniline dyestuff. If the latter is used, it can be dissolved in a small quantity of boiling water to which just a trace of acetic acid has been added, and the solution be poured in portions into the drum until the desired shade is obtained. The basic colors are best on these goods, and as they are selected for the grain side there need be no fear of damaged places showing, especially if care be taken to use only pure dyestuffs. An average quantity of ¼ per cent. is usually sufficient. To redress the leather after it is dyed some light fat-liquor, preferably egg-yolk and a little salt, is required.

The instructions that have been given for grain leather will

be found to give good results on suede leather also. It may be necessary to augment the quantities of dyewoods just a little, also to drum for a longer time, otherwise the directions should be carried out as given.

In working for grey shades, the skins must be washed back and then given a bath of chrome alum. For this purpose 2 per cent. of the weight of the dry skins should be used and twenty minutes allowed for the bath. A light boraxing should follow this, about 5 ozs. of borax to 100 lbs. of dry leather and ten minutes drumming being sufficient. Next prepare a bath consisting of the following solution: 3 lbs. gambier, 1 lb. sumac-extract crystals, and 3½ ozs. logwood crystals. The skins are placed in the drum together with 10 gallons of water at 80° F., and the prepared solution is poured in in portions at intervals of a few minutes. One hour should be allowed for dyeing before striking.

The latter can be done with copperas or better still with titanium salt. Corichrome salts may be used also, a good striking mixture being made up of 4 lbs. alum, 6 lbs. salt and 2 lbs. corichrome F. This is dissolved in 4 or 5 gallons of water, and the solution, after part of the dye liquor has been run off, is added to the remaining solution in the drum, which is then allowed to run for about 45 minutes. The re-dressing with eggyolk may be given to the skins immediately afterwards, or they may first be rinsed, drained and egged later on.

When dyeing black shades on alum leather it is necessary to wash the goods back in the manner directed. For chrome leather this is, of course, not necessary. The skins are then placed into the drum, in which a solution of the following dyewood extracts has been placed: 3 lbs. quercitron extract and 4 lbs. logwood extract. The leather should be tumbled in this liquor one hour. The color can then be struck by using an iron striker or some titanium or corichrome salt, fifteen minutes being allowed for the operation. If necessary a topping bath of basic aniline black can be given before the goods are fat-liquored, in order to obtain a deeper shade.

The following method gives excellent results in blacking

the flesh side of alum leather by the brush method: First brush the skins twice with a solution of bicarbonate of ammonia, 3 lbs. per 10 gallons of water, and then brush two or three times with the following solution: 2 lbs. logwood extract and 1¾ lbs. quercitron extract, made up to 10 gallons of water. Striking the color is accomplished by applying a solution of titanium-potassium oxalate, 2 lbs. in 5 gallons of water. The slicker should be used between the brushings, which may have to be repeated.

This process of dyeing can be also followed with good results on the grain side of skins intended for kid gloves, and also for the grain side of Cape sheep.

Chamois leather is so largely used by glove manufacturers that a few notes on the dyeing of such leather may not be out of place. The goods must be carefully prepared for dyeing before satisfactory shades can be obtained. The skins, as a rule, come into the hands of the dyer already bleached, bleaching being absolutely necessary for practically all shades. Unbleached skins, even for the darkest shades, do not dye satisfactorily, and for very pale shades only sun-bleached skins can be relied upon to dye properly, those chemically bleached always "throwing back" in the dyeing process.

The first step in the dyeing consists of a good degreasing and this is best accomplished by placing the goods in a bath of carbonate of soda, consisting of 2 to 4 lbs. of it for 100 lbs. dry weight of skins, and drumming for half an hour at a temperature of 85° F. This process must be carried out thoroughly, and should the first drumming not clear the skins entirely another drumming must follow. The goods should then be rinsed in clear water and mordanted with titanium salt or chrome alum.

For light shades, a good process is to run the skins first in a 2 per cent. bath of titanium salt and then give them a bath of powdered sumac for thirty minutes. After this they must be well rinsed and freed from adhering sumac. Instead of this process, however, a bath of 2 per cent. of chrome alum can be given for twenty minutes, the goods being afterwards well boraxed.

They are now ready for the dyeing, which can be done with wood dyes, acid or basic anilines, or with alizarine dyestuffs, either alone or in combination.

Following the above preparation for light shades, the dyeing can be accomplished by using about 2 lbs. of acid dyestuff for 100 lbs. of leather. This must be dissolved in 2 or 3 gallons of water and put into the drum in portions at intervals of five minutes, and the whole drumming continued for thirty minutes. It is necessary to add a quantity of bisulphate of soda equal to the weight of the dyestuff to the dye bath towards the end of the dyeing, or, if preferred, in two portions, the first after fifteen minutes drumming and the rest soon after the whole of the dyestuff has been added.

For glove-leather shades the mordanting should be somewhat different, and should be carried out by employing, after degreasing, a 2 per cent. solution of corichrome G N for twenty minutes, or the above-mentioned chrome-alum solution, and then adding to the liquor, the following crystal dyestuffs in solution: Fustic, 3 lbs.; Brazil wood, 1 lb.; logwood, ½ lb. dissolved in 4 gallons of boiling water. Strain the solution and pour it in at intervals through the feed-pipe. Darkening, if necessary, can be accomplished by using from 3 ozs. up to 12 ozs. of bichromate of potash.

When dyed, the skins should be rinsed and then given a light fat-liquor, preferably one containing eggyolk. A lighter shade can be produced by substituting Cuba-wood crystals for fustic and reducing the quantity of logwood, etc. When dyeing with wood-dye crystals, the quantity of the same can be easily varied to produce different shades. It is hardly necessary to point out that the colors produced by this method are of wonderful fastness. A top shading can be done by adding a little basic dyestuff to the dye bath.

A popular shade of brown much in demand for gloves is produced by mordanting as above and then dyeing directly on to mordant with 2 to 3 per cent. of leather yellow T B or leather brown N B. To obtain a good black two dyeings are necessary. After mordanting with chrome alum, prepare a

solution of 4 lbs. logwood and 1 lb. fustic crystals in 5 gallons of boiling water, adding a little ammonia and sufficient water to make 10 gallons of liquor. Drum the skins in this solution thirty minutes. To strike the black use copper or titanium salt; add to the dye liquor and run twenty minutes longer. The goods are then rinsed and dried. The second dyeing takes place in the drum with a 2 per cent. solution of leather black, dyeing for twenty minutes; a light fat-liquoring then completes the process, and is followed by rinsing, striking out, drying and finishing as usual. The quantities stated are sufficient for 100 lbs. of dry leather. The dyeing should be done at a temperature of 85° F.

METHODS OF USING PATENTED DEPILATORIES.

In addition to sulphide of sodium, used for the purpose of removing hair and wool from hides and skins and preparing them for tanning, there are obtainable patented depilatories, which have many points to recommend them, being very satisfactory for both wool-pullers and tanners to use, and the leather that is made from skins treated with them is characterized by toughness, pliability and fine grain. These depilatories are used in various ways according to the kind of skin that is being treated and the qualities that are desired in the finished leather.

The crystals should first be dissolved with boiling water into a liquid. Being a compound, the material is simply reduced with hot water and not allowed to settle, all of the resulting liquor being used, because the settlings constitute a valuable part of the preparation, forming a slight carrying body, which adheres to the skins and does not gum or injure the wool, but on the contrary makes it clean, soft and silky, equal to sweated wool.

The strength of the solution should be for salted skins, 12° to 25° Bé; for thin, open wool skins, 14° to 18°; for thick, heavy merino and bucks, 18° to 24°; for milk lambs, 18° to 24°; and for use upon goat and kid skins the same strength as upon sheep and lamb skins. The strength, however, need

never be greater than just sufficient to start the wool or hair; if applied stronger than this, no injury results to the skins, it being merely a waste of material.

The skins should never be allowed to heat before or after treatment nor at any stage of the process. Salted or dried stock should be soaked from 24 to 60 hours, and after washing and breaking thoroughly, be well drained of water or extracted before being painted with the depilatory. The wool or hair usually starts in a few hours after painting, and it is well to unhair or pull promptly, say the next day. Young lamb or kid skins, on which the depilatory is used full strength, should be pulled as soon as the hair or wool starts, and immediately put into clean cold water and then lightly limed for from six to eighteen hours. All skins, after pulling or unhairing, should be immediately put into cold water, to which some depilatory has been added; in this they are safe for some time and in no danger of heating or spoiling. No depilatory-treated skin will suffer injury so long as it is kept moist and not allowed to dry or become hard. The first lime can be half renewed for each batch of skins by adding one bucketful of lime for every four hundred skins. It should always be kept clean and sweet and used only once, and the skins may remain in this lime over night, or from twelve to fifteen hours in warm, and from twelve to thirty-six hours in cold, weather. The second lime should be made entirely fresh, using about 2 bucketfuls of lime to four hundred skins. The skins may remain in this lime from one to two days in hot, and two to four days in cold, weather, when they will be sufficiently limed for ordinary purposes. If they are to be tanned without pickling, a little more lime may be necessary and will do no harm; if highly limed stock is desired, a third and even a fourth lime may be used. It will be found advantageous, in case still limes are used, to pull the skins out daily while liming and it should always be borne in mind that the stronger the solution of depilatory is and the less it is washed out before liming, the less liming is required. After the skins are taken out of the lime, they

should be washed in clean, cold water, fleshed and drenched or bated, next worked on the grain side, then trimmed and put into clean water and passed into the next process of pickling or tanning.

In the treatment of light hair skins, such as goat and kangaroo skins, when it is not desired to save the hair, they can be soaked and softened, and then put into a liquor made up of from 10 to 15 lbs. of depilatory to every 100 gallons of water in the vat. The depilatory should all be dissolved and the liquor well stirred before the goods are put in. Keeping the skins in a solution prepared in this manner for twenty-four hours, with occasional stirring about, results in dissolving the hair, which can then be easily removed by washing in cold water. The mixing of lime with the depilatory is not recommended, as the stock will be not quite so soft as when the depilatory is used alone. In case dry skins do not get thoroughly softened before they are put into the solution of depilatory, they may remain in the liquor for from 24 to 48 hours or until they are soft and plump. No lime should be applied until they are completely softened. After having been washed to remove the dissolved hair, they may be lightly limed for a few days, then fleshed and drenched.

If it is desired to save the hair, the skins should be soaked in the usual manner and the water then extracted by means of a hydro-extractor, or by thorough draining. They may then be painted with the solution of depilatory, at a strength of 18° Bé. Each skin is then folded lengthwise, flesh side in, and allowed to lie until the next day, when the hair may be easily rubbed off; the skins are then washed and limed for a few days. It is always advisable to handle the skins promptly and to allow no delay to take place between the operations, especially in hot weather. The limes should be kept sweet and clean, and the stock be frequently handled and carefully drenched, for it is during these processes that the character of the leather is largely made.

When the patented depilatory is used upon hides intended for sole leather, the unhairing should take place as promptly

as possible, and in such a manner as not to affect the weight of the stock, nor to remove substance and impair the strength of the leather. The usual method employed, after the hide is soaked, is to spread it out on a smooth surface, hair uppermost. If no value is placed on the hair, the hair side is painted with the solution of depilatory, either clear or mixed with lime in the proportion of well slaked lime, 3 parts, depilatory solution of 18° Bé., 1 part. The lime should be well slaked and the depilatory crystals dissolved before they are used. The solution may be applied with a vegetable fiber or tampico brush or a swab made of burlap or bagging.

After the mixture has been applied, the hide should be doubled up carefully and covered so as to exclude the air and to prevent the drying of the paste. If the hair is to be saved, the flesh side must be painted and the hair kept clean. The hide should be kept in a cool, damp place until the hair is loosened, when it is opened out, washed and unhaired. The flesh side is next made clean and smooth and the grain worked out, and the hide is then ready for tanning.

The unhairing can be done another way. A vat is partly filled with water and from ½ to ¾ lime and ¼ to ½ depilatory liquor of 18° or 20° Bé. are added thereto and well mixed. Then the hides are thrown in and left in twenty-four hours. The use of the lime is however not necessary, and a liquor of nothing but depilatory crystals of a strength of from 5° to 10° Bé. may be used. In this the hides may remain until they are thoroughly softened and the hair comes off readily. Only hides that are intended for hard, solid leather should be treated in the above manner. The hair is lost, but this loss is made up by the extra quality of the leather and the increase in the weight of it gained, the superior, fine, close grain, exceeding toughness and pliablity, and saving of time and labor.

For belting, harness and patent leather, the hides may be painted upon the flesh side and unhaired as soon as the hair is loosened, then limed a few days, bated, pickled and tanned. By painting hides or skins, and after unhairing, a further

swelling may be considered necessary for easier fleshing, scraping, beaming or splitting. This can be effected by means of freshly made, weak depilatory solution alone, or the water the painted hides have been washed in after unhairing can be saved for the purpose, or weak, clean limes as for light skins be used, the strength of the liquor being reduced or increased as circumstances require. The proportion of depilatory necessary for swelling and liming purposes is from 1 to 2 ozs. for each hide; ½ to 1 oz. for each kip, and ¼ to ⅜ oz. for each calfskin. If the water is hard, a little more may be used. The swelling and liming are usually completed in from one to four days, depending upon the nature and condition of the hides or skins, the strength of the liquor, the weather and the temperature of the liquor or limes.

The unequal thickness of horse hides makes them particularly hard to unhair and to swell sufficiently for splitting, and to overcome this a depilatory liquor of 18° Bé. may be used on the fore part, and one of 24° on the hind part, used either clear or mixed with lime. After unhairing, the hides may be limed for a few days in weak, clean lime, the length of time of liming being reduced one-half. The subsequent treatment is the same as usually employed. Hog and alligator skins are limed in the same manner as horse and other hides.

THE PRODUCTIOM OF A GOOD COLOR ON HEAVILY STUFFED LEATHER.

The condition of leather as regards moisture is perhaps the most important point to watch with regard to the production of a good color. A leather containing too much moisture absorbs the grease with difficulty, but leather which is dry absorbs the grease too readily and allows it to remain on the surface, producing a dark color. The fineness of the division of the oil also determines the color of the resulting leather. The more finely divided the oil the more likelihood there is of producing a clear color. It is for this reason that emulsions of oil have advantages over pure oils and since degras produces one of the best emulsions known, it is in great favor with curriers, when a light color is desired.

The nature of the greases which enter into the composition of the stuffing mixture is of first importance from the point of view of color, it being a good plan to have as large a proportion of hard grease as possible, keeping in mind the degree of suppleness desired. Solid greases which can only be introduced into the leather by the aid of heat, possess the property, during cooling, of lightening the color. The use of stearine instead of tallow may be of advantage if the leather is originally sufficiently soft, since it produces greater firmness than tallow.

In recent years many solid mineral greases have been put on the market, which possess the double advantage of producing good color and of being cheap. Certain of these products have the special advantage of being emulsifiable with water, thus playing the part of a solid grease in the shape of a fine emulsion. It is also possible to mix these materials with tallow or stearine in such a way as to produce greases having varying melting points, according to the degree of suppleness desired. The solid mineral greases which are emulsifiable have generally melting points somewhere about 45° C. (113° F.) They may be used alone or in a admixture with tallow. If used with the latter, the melting point may go down to 35° C., (95° F.) which is helpful from the point of view of suppleness. They also may be mixed with stearine, or with a mixture of tallow, stearine and moellon. By this means it is possible to obtain a much brighter color than was formerly possible by the old processes of currying, a greater quantity of grease being at the same time introduced. This is not harmful to the quality of the leather, but rather beneficial. Goods thus stuffed have, in fact, a greater tendency to maintain the dry appearance which is the accompaniment of well-stuffed leather.

One of the features of the superiority of modern currying as viewed from the final color of the leather, rests in the feasibility of stuffing the leather in a drum. It will be readily understood that this treatment possesses the advantage of increasing the fineness of the division of the grease, thus allow-

ing it to penetrate the fibers of the leather and to be assimilated more readily, all of which helps in the production of a satisfactory color. To this advantage may be added the fact that a considerable proportion of hard grease, at least 25 to 30 per cent. of the total, can be used, and a finished leather will be produced, which in drying will not make apparent the amount of grease which has been incorporated.

For the drum stuffing of leather, there are two common ways of proceeding, the first being to apply the grease to the leather on the table, and when thus plastered to drum it in a heated drum. The second method of manipulation is to warm up the drum and after introducing the leather, turn it for a few minutes to warm it. The grease, at a suitable temperature, is then put in and turning continued from one-half to one hour, until all the grease has been introduced. Those curriers who are in the habit of using the first method give it preference. It is certainly true that by it a leather of good color is very easily produced, but it is probably also true that a less quantity of grease is introduced than by the second method. If it is not desired to introduce into the leather a great quantity of grease, then this first method, that is, to apply the grease on the table and drum afterwards may be used; but it is quite probable that just as good a color may be obtained by the second method, and at the same time a larger proportion of grease be introduced. The chief reason why some curriers do not succeed with the second method, is that they do not sufficiently study, before stuffing the leather, its condition as regards moisture, its proper condition in this respect being indispensable for success. If the hollow or loose parts of the leather are not sufficiently dampened at the moment the goods are put into the drum, they will absorb too much grease, and too dark a color will result, while the other portions will remain insufficiently stuffed and be of a much lighter color. The result is bad.

The secret of success in direct drum stuffing rests in putting the leather into proper condition as regards moisture before stuffing; this work should be entrusted only to a skilled man,

who can detect at a glance the hollow part in the leather and how much moisture should be given to it. Once the leather is properly dampened, giving more to the hollow parts, it should be placed in a pile for a sufficiently long time for the moisture to be evenly distributed among the fibers, and then to proceed to the stuffing. With these precautions observed, the second method of manipulation will give a color just as good as the first, and in addition it will allow of a much larger proportion of grease to be introduced into the leather.

As a final precaution the stuffing formula should contain an emulsifying agent, which will insure a perfect emulsion of the whole, for example, soluble oil, moellon, or one of the mineral greases above described, which being themselves emulsifiable, impart this property to the other greases.

Certain curriers make it a practice to open the door of the drum after the absorption of the greases, and to continue the turning of the drum until the greases solidify. There is, however, no marked advantage in this method. It seems preferable, as soon as the grease has been absorbed, to remove the leather and to hang it up until it is cold. After this, it is good practice, if there are no special disadvantages in it, to soak the goods in a sumac bath for one or two days until complete penetration has taken place, and finally to set them out. In this way, other things being favorable, a perfectly satisfactory color will be obtained.

The stuffing of belting leather can be carried out either on the table or by immersion. There is an indispensable precaution to be taken in order to produce a good color, and that is, when stuffing is carried out by hand, to lightly moisten the grain, in order to prevent the grease from penetrating through to it. Without this precaution, the grease traverses and makes the surface a dark color. On the other hand, moistening the grain causes the grease to set the moment it reaches it, and thus helps to maintain the color.

There is also another method of procedure which gives good results and that is: The grease must be appreciably hotter than the leather. On a table, which should be a little

larger than the butts, are placed a certain number of pieces of stuff capable of absorbing moisture easily. These pieces should be as large as the table itself, and on top of them is placed a similar piece of fustian, the whole forming a soft cushion on the table, which is kept wet. Each butt, on coming from the hot chamber, is placed grain downwards on the cushion, and the grease is applied to it in this position. The cushion by its softness adapts itself to the surface of the butt, and its moisture prevents the grease from penetrating to the grain, because, as soon as the grease traverses the leather and reaches the moist grain, it sets. In spite of this, it is essential that the grease should be applied as rapidly as possible, for the butt must be allowed sufficient time to cool down during the process. Finally, great care must be taken that the temperature of the grease always remains the same. Immediately after this application of the grease, the butts are immersed either in cold water, in weak liquor, or in a sumac liquor and left there two or three days. This obviates drumming the leather after stuffing, an operation which always causes a loss of weight. The longer the butts are allowed to lie in this liquor, the greater the chance of causing the dark stains which may have been produced on the grain, to disappear. The butts are finally rinsed in cold water and set out carefully on a table. The grain is moistened regularly with water, and a mixture of tallow and cod oil in equal proportions is applied to it cold, a good natural color being thereby produced. If a lighter color is desired, less grease is given. There are other precautions which may be taken after stuffing, which help to produce a good color. In the first place, the drying after stuffing must take place very slowly, slow drying causing the grease to be finely divided.

The temperature of drying must not be too high, or otherwise the grease will melt and appear on the surface. It is, however, necessary that the drying should be carried out in a sufficiently high temperature for the greases to remain soft in order that they can be finely divided as they penetrate to the interior of the leather. The temperature most suitable must

be determined according to the melting point of the grease employed. In some works an economy of time is effected by not drying out completely, but by setting out in the half-dry state. It is, however, much preferable to dry out completely and to dampen back again regularly in order to set out. This precaution is especially to be observed when dealing with leather stuffed by dipping. It is good practice after currying, to leave the goods in the warehouse for a sufficiently long time for the grease to be properly assimilated in the interior of the leather. After this warehousing, the last trace of grease which remains on the grain may be removed with care by means of a fine slicker.

The process of bleaching, which contributes to the production of a regular and light color, can be carried out after tanning, either before or after stuffing. In principle, bleaching before stuffing is to be preferred. Weak solutions of oxalic acid, sulphuric acid, or oxalate of potash or sulphurous acid are used. There are also on the market products called hydrosulphites, presented either under this name or under special trade-marks. These materials enable one to produce an efficient bleaching in a very simple manner, the solution being prepared at time of using. In spite of the superiority of bleaching before stuffing, it often happens that it is more convenient to bleach after the stuffing. A method of bleaching leather which has been stuffed with a large quantity of grease is as follows: The first precaution is to remove completely from the surface of the grain all excess of grease. The butts are placed in a pile for 24 hours and immersed for one minute in a bath at 25° C. (77° F.) containing 3 per cent. of caustic soda, the leather thereby becoming very dark. It is washed in tepid water, and then placed in a cold 5 per cent. solution of hydrochloric acid until it becomes light again, when it is carefully rinsed with cold water. This process must only be taken as an example. In principle, the processes of bleaching used before stuffing may be equally as well used after stuffing, but in order to make their application successful after stuffing, it is essential that every trace of grease

shall be removed from the grain. This can be accomplished by means of a good washing with a soap solution followed by careful rinsing. The ordinary process of bleaching can then be applied, and may be combined with treatment with sumac. For belting leather the butts, after having been washed and set out by machine on flesh and grain, are placed in a pit together with a strong, lukewarm sumac liquor and left therein one day, being removed two or three times. The sumac may also be given in a drum for one or two hours. The butts are set out on a table with a stone slicker, carefully brushed, allowed to dry gently, and placed in a pile when half dry. Treatment in a sumac bath helps to brighten the color of harness leather also. The quantity of sumac depends upon the nature of the original tannage, but about 2 lbs. per butt is an average quantity. In the manufacture of harness leather, and especially for leather that is to be stained with light colors, special precautions are sometimes taken. In the first place, only hides of particularly good color are selected. After shaving, they are drummed in a sumac bath, which has already been used once before, then set out by machine. They are then given a second sumac bath, this time one freshly prepared. The treatment with sumac does not necessarily exclude chemical treatment with oxalic acid. If the two processes are combined, the color obtained is even still lighter. If the suggestions that have been given are followed, it is possible to obtain a leather which has absorbed a considerable quantity of grease and is of sufficiently light color and dry appearance to satisfy the most exacting customer.

ONE-BATH CHROME TANNAGES.

While a great many receipts have been published for one-bath chrome tannages, the preparation of a proper one for any given purpose is still considered a valuable trade secret. The principal reason for this is that, in general, the underlying principles are not sufficiently understood, and thus the delicate variation of the components of the tan liquor to suit certain requirements is a matter of experience and not of scientific

prevision. A little consideration of the one-bath chrome tan liquor from the chemical point of view should therefore be of some interest.

First and primarily important from the economic side, is the source of the chromium. Sodium bichromate is almost universally the cheapest raw material. The exception is chrome hydrate, it being occasionally possible to obtain chromium in the form of hydrate relatively cheaper than in the bichromate of soda. This is so because in some chemical operations the bichromate of soda is used simply for its oxidizing effect, and when the chromium is reduced its work is done; then it is precipitated with sodium carbonate, washed and offered for sale as a by-product. Only a limited supply, however, can be obtained from this source in this country; but abroad, large quantities are secured from the aniline color works. Bichromate of soda contains almost exactly 50 per cent. of chromium oxide, 100 per cent. chromium oxide in this form therefore costing just double the price of the bichromate. As in the bichromate the chromium is present in the form of chromium anhydride and, for use in one-bath liquors, must be in the reduced or chromium oxide form, there has to be added to the cost of the bichromate that of the acid required to set free the chromic anhydride as well as that of the reducing agent used to get it into the chromium oxide form.

For example, the cost of a liquor containing 100 lbs. chromium oxide made by reducing soda bichromate with glucose may be figured as follows:

200 lbs. Sodium Bichromate @ 7 cents per lb. .	$14.00
280 lbs. Sulphuric Acid @ $1.10 per 100 lbs. .	2.98
50 lbs. Glucose @ 3 cents per lb.	1.50
Total cost of Chromium Oxide	$18.48

In place of the glucose, sodium bisulphite may be used as the reducing agent, in which case the cost shows as follows:

200 lbs. Sodium Bichromate @ 7 cents per lb.	$14.00
163 lbs. Sulphuric Acid @ $1.10 per 100 lbs. .	1.80
600 lbs. Bisulphite @ 85 cents per 100 lbs. . .	5.10
Total cost of 100 lbs. of Chromium Oxide . .	$20.90

These liquors as calculated include the cost of the acid which is required to hold the chromium oxide in solution. If chromium hydrate is used the cost of this acid must be figured; for example, the chromium hydrate is usually sold in the form of a 20 per cent. paste, and the cost of a liquor containing 100 lbs. chromium oxide is:

500 lbs. Chromium Hydrate @ 3½ cents per lb.	$17.50
210 lbs. Sulphuric Acid @ $1.10 per 100 lbs. .	2.31
Total Cost of 100 lbs. of Chromium Oxide . .	$19.81

The cost of a liquor made of chrome alum to contain 100 lbs. chromium oxide is readily calculated, as this salt contains almost exactly 15 per cent. of chromium oxide; therefore it requires 667 lbs. chrome alum to supply 100 lbs. chromium oxide.

667 lbs. Chrome Alum @ 5 cents per lb. . .	$33.35
Total Cost of 100 lbs. of Chromium Oxide . .	$33.35

The cost price of the materials are fairly accurate on present market conditions, and as the market fluctuates new values can be readily substituted in the tables given.

The Next Step.—Ascertaining the cost of chromium oxide is only the first step in the preparation of a liquor suitable for tanning. The next step is to so modify the liquor that it will produce good leather. This is a matter of so much importance and so little understood, that a great many tanners find it good business policy to rather pay an extra price for a liquor already prepared and which has been accurately adjusted to conditions they desire, than to attempt to make a liquor of their own. In general, this desired modification of a tanning liquor is described by the rather vague term of basicity. To properly understand what is meant by this, we must consider a little the theory of the one-bath chrome tannage, that it, so much as is known of it. According to our best present knowledge, salts of all descriptions when in solution dissociate, that is, break up into acid and basic radicals or ions, and the chemical properties of these ions constitute

the properties of the solution. In the case of salts of strong acids and strong bases, such as sodium sulphate or sodium chloride, the strong basic or positive character of one ion is in effect neutralized by the strong acid or negative power of its opposite ion, and there results in a solution of such a salt a neutral solution. On the other hand, with a salt of a strong base and a weak acid, as sodium carbonate in solution, there is a condition in which the strong positive character of the sodium ion far over-balances the weak acid character of the carbonic ion, and the solution has marked basic or alkaline properties. While in the salts of weak bases and strong acids, such as aluminum and chromium sulphates, the acidic or negative character prevails, and solutions of these act in many ways as if they contained free acid. In fact, the solutions may to a certain extent, be said to contain also free acid by the taking-on of water—the phenomenon known as hydrolysis —which is connected with the facts of dissociation already cited, in the equilibrium, as it is called, of the solution. With these theories in mind, we can perhaps consider and explain better some of the observations on the behavior of the chrome tan liquor. An untanned hide or skin is strongly swollen or plumped by both acids and alkalies. The reason for this phenomenon has never been adequately demonstrated. Perhaps as good a theory as any other is that both the acid and alkali combined chemically with the hide fiber in such a way as to reduce its permeability and thus the fibers become swollen by solution-pressure. Neutral salts deplete, reduce or prevent any swelling of the hide. This phenomenon likewise has not been thoroughly explained, but it, too, is doubtless connected with the increase of osmotic or solution-pressure.

If a chrome tanning liquor is made up of chromium sulphate and nothing else in solution, it will from the considerations above be seen to possess strongly acid properties. A skin immersed in such liquor will be excessively plumped, the tanning, however, will proceed very slowly, because as the tanning proceeds the deposition of the chrome oxide will continually augment the acid character of the liquor, and by so

doing the tendency of the chrome oxide to deposit will be retarded, until finally a condition is reached when no oxide whatever is deposited, that is, the liquor will cease to tan. If to the liquor containing only chromium sulphate common salt be added, the percentage of acid will not be reduced, but the plumping effects will be. Such a liquor will tan with the same degree of slowness as a pure solution of chromium sulphate, a better leather being, however, produced, because the excessive plumpness is prevented. If in addition to the common salt, sodium carbonate be added to the liquor to neutralize the acid formed by the hydrolysis of the chromium sulphate, there will be present the third factor necessary to complete the tan liquor.

By combination with the acid the sodium carbonate forms sodium sulphate, and this being a neutral salt, will assist the common salt in keeping down the plumpness, or in practical effect, serves to decrease the quantity of common salt that is necessary to employ for this purpose. The amount of sodium carbonate that can be added is of course strictly limited, because an excess will cause the precipitation of chromium hydroxide, and even before this point is reached, so much of the acid may be neutralized that the solution will be unstable and practically decomposed by the skin. A solution in this condition will be found to plump as much as a strongly acid solution. It should perhaps be noted here that there is a difference between the rapidity with which solutions penetrate and the speed with which they tan. The acid solutions penetrate more rapidly than neutral solutions, but do not tan so fast; thus a skin struck through in a too acid solution will be found to be undertanned. In practice only the tan liquor made by the solution of the chrome hydrate in sulphuric acid will be found simple enough to modify as above described.

The liquor made by reducing the bichromate with glucose will contain considerable sodium sulphate and some salts of organic acid, obtained from the incomplete oxidation of the glucose. The influence of these latter is, however, almost negligible in regard to diminishing the plumping effect, but

they do retard the tanning. As the amount of such salts is variable according to the temperature at which the bichromate has been reduced, they constitute an objection to the tan liquor made by reduction with glucose as they make its action slightly uncertain. The liquor made by the reduction with bisulphite is therefore slightly superior in its regularity, although a shade more expensive.

The concentration of the liquor also exerts a pronounced influence on its tanning properties. In the first place all the constituents of a liquor should be proportioned to each other and for sure results their ratio should not be changed. It should be borne in mind that the neutral salts are a constant factor while, because of the chromium oxide being taken up by the skin, the amount of this and of the acid present is variable, the one constantly decreasing and the other constantly increasing.

Finally of utmost importance is the condition in which the skins are when they are put into the tan liquor. They may be acid or neutral, plump or depleted, but their condition should always be the same, or allowance made for it in the tan liquor.

A PROCESS OF MANUFACTURING CHROME CALF LEATHER.

The skins that are most suitable for dull-finished or glazed-finished leather are those that weigh from 5 to 7 lbs. each, green-salted. The stock is shaken free from salt, and after trimming, is placed in fresh water for twenty-four hours. The excess of salt and dirt is removed by washing in running water for fifteen minutes, the skins being next fleshed. Depilation is begun by using 5 per cent. of hydrated lime on the weight of fleshed stock in sufficient water at a temperature of 70° F. After the skins have been put into the lime, the paddle is turned from time to time, and the following morning another portion of 5 per cent. of hydrated lime is added. A fresh portion of lime is also added on the next two days, the temperature of the liquor being maintained at about 70° F. At the end of five days the skins are withdrawn and should

be in proper condition for unhairing. They are thrown into warm water for one-half hour, then unhaired over the beam.

A bath of oropon bate is prepared consisting of 8 ozs. of oropon for each 100 lbs. of stock to be treated. The temperature is 100° F. at the start. The stock is turned from time to time and allowed to remain in the liquor over night. On the following morning the skins should be soft and open and free from lime.

The skins, after washing, are placed in a drum and in a barrel is placed ½ gallon of water for each pound of stock. To this water are added 12 per cent. of salt and 1½ per cent. of sulphuric acid. The solution thus prepared is poured through the trunnion while the drum is in motion, and the drum is run one hour. The stock is allowed to remain in the drum over night and is run another half hour in the morning. It is then horsed up and allowed to drain.

The tanning is effected with tanolin crystals. The drained pickled stock is placed in the drum together with 8 gallons per cent. of water and 6 per cent. of salt, and run for fifteen minutes. Six per cent. of tanolin is dissolved in 2 gallons of boiling water and the solution is allowed to cool before it is used. One-third is added to the contents of the drum and the skins are run one-half hour; another one-third is then added and the drum run one-half hour; finally the remainder of the solution is introduced and the goods are drummed one hour. Eight ounces of sodium bicarbonate are dissolved in a little water and poured into the drum, which is then run for two hours; then six ozs. more of the soda are added for each 100 lbs. of stock and the leather is further drummed until it is well tanned.

After having drained on the horse for forty-eight hours, the skins are thrown into the drum and a solution of 1 per cent. of borax is added. The leather is drummed one-half hour, then washed in running water for one-half hour, struck out and shaved.

The shaved leather is put back into the mill together with 12 gallons of water at 125° F. for 100 lbs. of stock; and as

the drum rotates 1 lb. of hematin dissolved in boiling water made alkaline with ammonia is poured through the trunnion, and the drum is run fifteen minutes. One and one-half pounds of chrome-leather black C is dissolved in boiling water and added to the contents of the drum and the leather is run fifteen minutes longer.

Fat-liquor is next poured into the drum without previously removing the dye liquor and the leather is drummed one-half hour. It is then oiled on the grain, dried, staked, seasoned and finished.

FANCY LEATHER CALFSKINS.

Only the finest calfskins are selected for this class of leather, and they should as far as possible be free from butcher cuts and other imperfections. The weight of the skins for this line of manufacture usually runs from four to seven pounds each. They are generally green-salted or in a dry-salted condition, and must be soaked in water in the usual manner and made soft and clean.

One hundred skins make a convenient-sized pack. They are first run in a drum which permits of a constant supply of water being run into it while it is revolving, and which has openings for the water to run out again. If the pack is green-salted one or two hour's washing is sufficient; but dry-salted stock requires longer treatment. The main object to be attained is to get the skins soft without the loss of substance, and this can be greatly accelerated by having pegs inserted in the inner side of the drum. The skins are next fleshed and limed.

During the liming of this class of leather the tanner must bear in mind that the finished product is required to be very soft and have a tight, smooth and clear grain. In order to attain these objects, great care and judgment must be exercised at this stage of manipulation, for as most tanners know, the liming makes or mars the finished product. The local conditions must be reckoned with, as well as the season of the year. The water that is used also has an important effect

upon the quality of the leather. Very soft water tends to produce open-grained leather that pipes readily, while that produced with very hard water is hard, flat and tinny. It is generally considered best, however, to use water that is somewhat hard. Lime and arsenic are the depilatories used. The arsenic is valuable, not only in hastening the loosening of the hair, but also for the softening effect it has upon the skins, rendering them supple and making the grain close and smooth.

The skins, flesh side down, are first put into old lime. After remaining in this one or two days, they are hauled up and allowed to drain, preparatory to going into an entirely new lime made up in the following manner: 100 lbs. of lime and 2 lbs. of red arsenic are slaked together in a tub, and put into a vat which is then filled with water, and the whole well plunged, when the skins are thrown in, one by one, flesh side down. The next day they are hauled out, allowed to drain and put back. On the third and sixth days they are hauled out and the lime is strengthened by the addition of about half the above-mentioned quantities. On the ninth day the hair should slip off easily and the liming is then complete. In the summer time a little shorter time may suffice; in the winter a little longer time may be necessary. Judgment must be used. Following the unhairing, the skins are well washed in running water until the surface lime is removed; they are next bated and delimed. Deliming is done in one of the several bating processes that have been described for calfskins, the method of bating with oropon, or the process in which glucose is used being especially suitable. The skins should be bated in such a manner that they are soft and clean, and have the fine grain that is desired. After having been bated, they are scudded. This is done on a bolstered beam, using a slate knife, and is an important operation. It removes much of the dirt and rids the skins of lime dissolved by the bate. Furthermore, all the fine young hair which may still be in the skins is removed. The skins are next drenched with boric acid, formic acid or any other suitable drenching material and are then pickled.

Pickling for this class of leather is effected very satisfactorily with formic acid and salt, which cleanses the skins and gives them a nice grain. Pickling makes soft leather which has a clear grain and good color. Quebracho extract is commonly used for tanning skins for fancy leather. A quantity of it is dissolved by boiling in water in a barrel, thus forming a stock solution from which the tan liquors are made up and strengthened. The skins are held in suspension in the vats by tacking them on to wooden strips, using galvanized iron or copper nails so as not to stain them. One nail on each butt shank is enough, two skins on each side of the strip, with the grain side out, being thus suspended.

The first liquor in which the skins are hung is quite weak, from 7° to 10° barkometer. As the tanning progresses the strength of the liquor is increased, so that at the last the liquor will show a strength of 20° to 25° barkometer. The chief point to be considered is to avoid drawing the grain by using too strong liquors at first. Salt must always be present in the liquor, especially when sulphuric acid is used as a pickle, to prevent the salt in the skins from being washed out, leaving the acid to work injury. The time required for tanning varies according to the handling of the skins and the strength of liquors, but should be accomplished in from seven to fourteen days.

When the tanning is completed, the skins should receive a slight fat-liquoring. This may be sulphonated oil, or such oil and degras, or a mixture of soap and oil made as follows: Put 10 gallons of water into a clean barrel. Dissolve 1½ lbs. of soda crystals or powdered borax and add the solution to the water. Add 10 lbs. of good soft soap, such as Palermo fig soap, and boil until dissolved. Then add 4 gallons of neats-foot oil and boil for a short time. Add about 10 gallons of water and the liquor is ready to be used. The grease should be entirely absorbed by the leather; the skins are then drained, slightly struck out on the flesh side or hung directly up and dried. When thoroughly dry they are sorted into various grades, those that are light in color, clear of grain and free of

imperfections being put into the lightest colors, while those that have slightly imperfect grains are most suitable for black leather.

To prepare for coloring, the skins are milled with a few pailfuls of sumac liquor for half an hour, when they are struck out by hand or machine. They are next shaved to the required substance and then passed into the dye bath. Dyeing is accomplished most satisfactorily in a revolving drum with direct dyeing blacks for black leather, and acid colors for colored leather. After they have been colored, the skins are struck out and tacked on frames and dried bone-dry. If intended for blacks, after shaving, they are drummed with sumac, put out, tacked and dried.

Finishing is done as follows: The skins are taken off the tacking frames and trimmed. A seasoning is prepared of 1 pailful of water, 1½ pints of milk, the whites of 2 eggs, well beaten, and ½ pint of flaxseed. The flaxseed is boiled with a little water. It must be boiled carefully and for a long time. It is then strained and the residue thrown away. Before it is used, the flaxseed should be beaten up the same as the white of an egg. The skins are seasoned, dried and rolled on a machine or ironed.

Skins for black leather should be dyed black upon the grain by the use of direct dyeing blacks, or drummed with such dye and dyed through flesh and grain. Russia-red calfskins are given a coat of birch oil after shaving and striking out, which gives the characteristic smell. After the first seasoning they are diced on a machine and then glazed. Sometimes it is necessary to season the stock twice. The finished leather should be soft and strong and have a good color. These qualities cannot be secured unless the skins are well limed, bated and pickled, and then thoroughly tanned.

THE DELIMING TEST.

In deliming limed hides and skins by means of acids, it is customary to determine the completion of the process by applying to a freshly cut section of the pelt a solution of phenol-

phthalein. If such a solution is applied to limed pelt the section shows red and, if to a completely delimed pelt, there is no change of color. A partially delimed pelt will show red in the middle and colorless at the outsides. Most tanners usually allow the deliming to proceed to a given point. For some purposes complete deliming is necessary, while for others a mere surface deliming is sufficient, the amount of deliming necessary depending upon the nature of the subsequent tanning process. For example, if it is a question of sheepskins, which are first delimed with acid, then bated or puered, the first actual acid deliming is usually carried out only to such an extent that a streak of free lime is left in the middle. With heavier classes of goods, such as sole leather, the extent of the acid deliming depends upon the nature of the liquors into which the goods are next placed. If the end suspension liquors are very acid in character, it is not as important to neutralize as much lime as if these liquors were only slightly acid. The phenolphthalein test can be applied with almost any acid, but there is one caution that might be mentioned in its use, and that is that its action is more qualitative than quantitative. A trace of lime will give as strong a coloration as a large quantity of free lime, and cases have been known where this has led to confusion. To make the matter clear it may be well to take a definite example.

Suppose fully limed sole butts are being delimed with one of the ordinary acids, and suppose that the amount of acid which is present in the liquor is not quite sufficient to neutralize the whole of the lime. At the beginning of the process the whole section will show red on application of phenolphthalein; after a short time the cut section will show red in the middle and colorless at the outsides. The depth of the outside strips will continue as the process goes on, until almost the whole of the acid has been neutralized by the free lime in the hides. When this point has been reached, there will be a minimum red section in the center, but afterwards the free lime in the center will gradually diffuse out to the extremities, and so, on appplication of phenolphthalein, the

whole section will show red. In this way it is quite possible for an almost completely delimed hide to appear as though it were not delimed at all. It is in this sense that the test is qualitative rather than quantitative. By taking cut sections at different stages of the process, and not only at the end, it is possible to determine exactly the actual extent of the deliming.—From the Shoe and Leather Reporter.

APPENDIX.

VARIOUS PATENTS RELATING TO TANNING, WITH SPECIFICATIONS.

Leather for Furniture, Upholstery, Carriages and Automobiles.

The object aimed at by the inventor of this process is the production of a finished leather that possesses great durability, freedom from cracking and other objections, and which will be cheap to manufacture. The desired qualities are attained by coating the leather with a number of coatings, the inner coating or coatings being elastic, at least one of them containing a relatively large proportion of non-drying oil or oil not readily oxidizable and of soluble nitro-cellulose, which is in solution with amyl acetate and diluted with alcohol. The innermost coating is formed by making a portion of the diluent of alcohol, which by its quick evaporation will cause the pyroxylin to set before the amyl acetate has an opportunity to penetrate the leather and deposit the pyroxylin on its surface in the form of a thin film. The inner coating or coatings will never entirely dry, owing to the large proportion of non-oxidizing oil employed, and will always remain in a sticky condition. The outer coating or coatings preferably contain a much larger proportion of pyroxylin and a smaller proportion of oil. The outer coating or coatings will be largely of pyroxylin and will set with a dry surface, which will cover and protect the inner coatings. The outer coating will be very much thinner than the inner coatings.

As a basis, real leather as distinguished from artificial

leather, is employed. Small skins or large hides may be used; and the process may also be applied with success to the less expensive splits as well as to the more expensive grained or buffed leathers. For the oil a non-drying oil is employed, that is, an oil that is not readily oxidizable. As examples of such oils, castor oil and peanut oil may be mentioned, both of which are abundant and serve the purpose admirably. Other oils, which answer the requirements, may also be used. For the nitro-cellulose a nitrated cellulose readily soluble in amyl acetate and methylic alcohol, such as pyroxylin or gun cotton, is preferable. This nitro-cellulose may be in solution in a solvent proper, such as amyl acetate, or in a solvent mixed with a diluent, as fusel-oil. Together with the oil and the nitro-cellulose, gums or other substances may be used to give body to the coating and pigments or other materials to give color, but they are not necessary.

One way of carrying out the process is as follows: The uncoated leather is first coated with a liquid containing the oil and nitro-cellulose in solution and diluted with alcohol, with or without other materials, such as gums or pigments. This inner coating is allowed to set at the ordinary temperature. The first or inner coating when sufficiently set will not be entirely hard and inflexible, owing to the presence of the large proportion of non-drying oil, but on the contrary, will be tacky and more or less soft, flexible and elastic. A second coating is then superposed upon it. This outer coating may be like the inner one, except that it has a smaller proportion of the oil. In this outer coating a larger proportion of pigment may be used, if desired, than in the inner coating. The outer coating in some instances may contain no oil whatever, the effect of the oil in it being secured by the combination of its nitro-cellulose with a portion of the oil of the inner coating. The idea of the outer coating is to serve as a finish to the inner coating, the latter being always soft, impractical for a leather finish. If desired, a third or other coatings may be added, these coatings being similar to the second ones.

As an example for carrying out the process the following

proportions may be employed: For a steer-hide split or cow-hide split of average thickness, for the first coating, a solution of about 13 lbs. of pyroxylin dissolved in about 13 gallons of a mixture of 3 parts of wood alcohol and 1 part of amyl acetate, which is at the rate of 1 lb. of pyroxylin to each gallon of solution. To this are added about 75 lbs. of castor oil, together with about 2 lbs. of any commercial pigment, depending upon the color desired, ground in about 20 lbs. of oil. There are therefore used about 95 lbs. of oil, so that the oil will be at the rate of about 7⅓ lbs. of it to each pound of nitro-cellulose. As an example, burnt umber may be used for some shades of brown.

The inner coating will set and will not permeate the leather to any appreciable extent. One reason why this is possible is the use of wood alcohol in large quantity, so that the composition will not entirely, or much of it, permeate the leather and change the character of the coating from one of great elasticity and of ability to stretch to a film formed largely of pyroxylin and incapable of being stretched. Instead of the wood alcohol some other material may be used to prevent permeation of the leather by the solution. For the second coating the same amount of pyroxylin and amyl acetate may be employed, but with a smaller proportion of alcohol, depending upon the weather during the operation, on account of the tendency of the coating to absorb moisture and then precipitate pyroxylin. To this are added 16 lbs. of castor oil, being much less than for the first coating.

The amount of alcohol used in the second coating depends upon the weather during the operation. The second coating is in a position to absorb moisture, while the first one is covered. Therefore, if moisture be absorbed, a spotted appearance in the coating results. It is possible to make it without alcohol, but the solution will penetrate too far unless other means be provided to prevent this, for the reason that the amyl acetate dries too slowly. The amount of oil in the inner coating is regulated by the thickness, texture, stiffness and, in some cases, by the method of tannage of the leather, and also

by the length of fiber on the surface if the leather is a split. A thick and close-textured leather requires a larger proportion of oil than a thin leather or one of open texture. In some instances chrome-tanned leather will require a smaller proportion of oil than a bark-tanned product. The hand-buffed and the machine-buffed leathers will require a smaller proportion of oil than the split referred to, assuming the proportions to be the same in both cases. The proportion of oil to nitro-cellulose should be varied when used in connection with other leathers, such as goatskin, calfskin, etc., according to the above rule. The proportion may vary from 7½ lbs. of oil to each pound of nitro-cellulose or even slightly more in some leathers, down to very much less in others. It may not well be reduced, however, below 3¼ lbs. to each pound of nitro-cellulose. This proportion of oil, it is to be understood, is to be measured by the amount of nitro-cellulose employed and does not in any way depend upon the amount of solution containing the nitro-cellulose.

The proportion of oil in the outer coating will vary according to the results desired. A smaller proportion of oil gives a drier feel. A larger proportion of oil gives a product with an increased sleekness of feel. The amount of pigment added should be sufficient to secure the desired depth of color.

The addition of gums or other oils may cause a slight reduction of non-drying oil. For instance, in connection with the example before given, if a gum or similar substance, such as camphor, is used, and which is soluble in the solvent employed to dissolve the pyroxylin without acting on it, it would be in the proportion of about ¾ lb. to each pound of castor oil used.

After the leather is coated, it may be further finished by graining, embossing or pebbling in the usual way.

The leather produced by this process possesses remarkable durability and freedom from splitting or cracking. It is particularly applicable for furniture upholstery, or for use upon carriages and automobiles, and in the construction of folding hoods or tops of carriages. In these situations the

leather is folded and subjected to severe treatment, strain and exposure to the weather, which ordinarily would cause cracking or flaking of the coating.

Leather made according to this process does not have the objections usually incident to goods made by old and well-known processes. It may be more cheaply manufactured and made with greater expedition than ordinary coated leathers. The successive coatings do not have to be baked and may be quickly dried without artificial heat. Furthermore, cheapness is secured by using cheaper grades of leather to form the basis of the coated product. Leather made according to this process from the split, deep split, or deep buff, is in every way as good, if not better, than as goods made from hand-buffed or machine-buffed leather according to the older processes. Furthermore, it has the advantage of not drying out or getting stiff by age, and it is not affected by cold weather. Patented by Leon Feval.

Pryoxylin in Finishing Varnish for Patent Leather.

This process is a method of finishing patent leather, which, it is claimed, is cheaper, quicker and more convenient of execution than other methods, and the character, gloss and wearing quality of the leather are enhanced.

In manufacturing patent leather, after a sufficient number of preparatory or ground coats have been applied and pumiced when dry to make them smooth, there is applied one or more finishing coats of a pure linseed-oil varnish for the purpose of giving the high gloss desired. The advantage of this process over the common method are as follows: The inventor has heretofore improved upon the common method by using for the preliminary coats a pyroxylin varnish and superimposing thereupon as a gloss-giving varnish a finishing coat of drying oil; but in either of these two old processes certain difficulties are encountered in the application of the finishing coat or coats of gloss-giving varnish. Thus, for instance, the application of the gloss-giving coat of linseed-oil varnish frequently produces small pimply specks. Again it is necessary after

drying the leather with the finishing coat of linseed-oil varnish in heated chambers to expose it for a certain length of time to the action of sunlight before it is sufficiently dry for shipment. This carries with it the necessity of large yards to be used in the sun-drying operation, the expenditure of considerable time, more especially in cloudy weather, and the constant watching of the skins and their removal to shelter in case of rain or storm. In addition to all this, the finished article produced by these old processes shows an inclination to crack by reason of the tendency of the linseed-oil coating to become brittle, and this cracking often occurs spontaneously without apparent cause by mere changes of temperature.

By means of this improved process, the above-mentioned difficulties are removed. It has been discovered, as a result of a long series of experiments, that if the gloss-giving or finishing coats consist of a mixture of linseed or other drying oil and pyroxylin in solution, with or without the addition of substances to increase the flexibility, the coats do not have a tendency to form a pimply surface, but dry smoothly and evenly. Again, the finishing coats can be sufficiently heated in the drying room for immediate shipment without the tedious exposure to the sun, thus insuring the continuity of the manufacture irrespective of climatic conditions. Finally, the finished article has lost much of its tendency to crack. The pyroxylin in solution which is added to the finishing coats of drying oil, not only seems to impart tenacity to these coats, but also to retard oxidation, which is constantly going on in the linseed-oil coats after they are dry. The proportion of linseed oil and pyroxylin may be varied within wide limits. Thus where the finished product is to be used for the tips of shoes, which are not subjected to much bending, a less proportion of drying oil may be used than when the leather is to be used in the body of shoes. The proportions of drying oil and pyroxylin in the mixture may be varied from such as contain more pyroxylin than drying oil to such as contain more oil than pyroxylin. In fact, somewhat small quantities of pyroxylin are calculated to impart to the mixture the

desirable qualities above enumerated. For the material above referred to, intended to impart flexibility to the finishing coat, any substance ordinarily employed to give flexibility to pyroxylin may be used, for instance, non-drying oils. There is first applied to the leather one or more of the usual preliminary coats such as linseed oil with a pigment, or a mixture of linseed oil and a soft rubber or a coating of pyroxylin. On these foundation-coats is applied one or more gloss-giving coats consisting of a mixture of a drying oil and pyroxylin, which is formed by dissolving the pyroxylin in one of its usual solvents, such as a compound ether or a ketone, and then mixing the pyroxylin solution with the drying oil in the desired proportion. There may be used for the gloss-giving coats a mixture of drying oil and pyroxylin prepared as follows:

Take a solution of pyroxylin in amyl acetate by itself or mixed with benzine or turpentine. Thus 6 ozs. of pyroxylin may be added to 1 gallon of amyl acetate. To 80 cubic centimeters of this solution may be added 80 cubic centimeters of linseed oil or linseed-oil varnish, that is to say, linseed oil which has been boiled with suitable driers. The preliminary coat or coats having been applied, the gloss-giving coat or coats, consisting of a mixture of a drying oil and pyroxylin in solution, are applied, and when these have been dried in heated chambers, the leather is finished and ready for its intended use. This process is patented by Byron B. Goldsmith of New York City.

Tanning and Plumping Leather with Formic Aldehyde.

The following process is a method of tanning that is designed for the final finishing of East India kips, goatskins, basils and white leather, and the improvement of hides and skins imperfectly tanned by vegetable tanning materials, so that the required plumpness, weight, color, softness and moisture-resisting qualities are obtained.

The process consists essentially of two steps, the first of which is concerned with the introduction of material which

will render the skin sensitive to the fixing or tanning agent employed in the second step. This results in a fulling or plumping effect, clearing the grain, and at the same time feeding the leather. The first step has the same purpose as that commonly attained by the employment of old and sour liquors and weak solutions of extracts which precede the actual process of tanning.

The second step consists of treating the hide or skin to the action of formic aldehyde, a material that possesses the property of fixing the connective tissue and fibers in the swelled and plumped, tawed or partially tanned condition, produced by the first treatment, and at the same time of fixing in, upon or between the fibers, materials previously supplied by the first step of the process to contribute special qualities, such as body, color, suppleness, weight, etc., essential to a solid and well-nourished leather.

The use of the formic aldehyde in the second step is not a mere aggregation of elements or materials, as it is in its nature and effects entirely different from the materials employed in the first step, and could not be substituted for them to produce the effects of the first step, while it possesses distinctive and positive characters by which it acts upon both the skin and the materials with which it has been impregnated by the first step in a manner peculiar to itself. The formic aldehyde is used in the second part of this process strictly as a tanning agent to render the skin non-putrescible and insoluble.

The following particular case will serve to illustrate the steps involved: Sheepskins, goatskins or hides, having been previously prepared for treatment by softening, unhairing and other necessary steps, usually referred to as "beamhouse treatment," are placed in a drum or reel, in which they may be agitated by the revolving of the drum, or the action of the paddles, or by any other suitable means. In the drum, for instance, is placed a solution of gambier extract sufficiently diluted to present the extract to the entire mass of skins, containing approximately 4 lbs. of gambier to each 100 lbs. of wet skins. The skins are then drummed in the gambier bath

until they are thoroughly permeated by the solution. When the gambier has struck through the skins, which may be ascertained by cutting into the thickest skin and examining the exposed interior, they are cleansed in clear water; but this washing may be dispensed with and the second step proceeded with at once.

The second step consists in subjecting the skins to the action of formic aldehyde, preferably in solution, although it may be employed in the state of gas, either in the same drum in which they were given the first treatment, or another drum may be used.

The amount of the solution varies somewhat but is based upon the weight of the skins to be treated, and it has been found in practice that 3 lbs. of commercial 40 per cent. formic aldehyde solution to each 100 lbs. of wet skins are sufficient for ordinary sheepskins and goatskins. The amount of water used should be sufficient to keep the entire pack of skins well wetted so that the skins will be uniformly treated.

The skins are subjected to the action of the formic aldehyde until they are permeated through and through and until they respond to the usual tests of good leather. In this particular case the time required is three hours. It is advisable to maintain the bath in the second step at a temperature of not less than 80° F., and not above 120° F., in order to secure the greatest efficiency from the formic aldehyde. After the skins are found to be thoroughly fixed by the formic aldehyde, they are washed and are then ready for the usual treatment employed in finishing. In case the formic aldehyde is employed in the form of gas, the following method is advisable: The skins, having been brought to the desired state by the first step, as has been described, an amount of commercial formic aldehyde solution, representing 3 lbs. to each 100 lbs. of wet skins to be treated, is placed in a suitable generator, and the gas generated is allowed to pass, by suitable connections, into the chambers containing the skins. The temperature of this chamber is maintained at from 110° to 120° F., and the temperature of the chamber should also be kept moist,

both of which conditions are readily secured by the admission from time to time of a small quantity of aqueous vapor by means of a suitable steam connection. The chamber employed should be a closed one and no larger than necessary to allow the skins to be fully exposed to the action of the gas.

If desired, the gas may be admitted to the drum in which the first treatment took place, or into a similar drum, and the skins agitated therein, or they may be stretched on frames and enclosed within a stationary chamber, in either case being exposed to the action of the gas until they respond to the usual tests for good leather, say for a period of six hours, the time depending, however, on the thickness and character of the skins under treatment.

The market supplies certain tanned or imperfectly tanned skins and hides, which have been subjected to the action of salt, flour, eggs, vegetable extracts, gambier, cutch, tannins or other materials, which do not constitute high-grade leather, but which may be greatly improved. The effects produced on these skins are analogous to those produced by the first step of the process, and it is advantageous to take such skins and after softening them in water to proceed to treat them as described in the example cited for treating raw stock, whereby the results of the first step are secured with less time and material than are required in the treatment of raw skins. In certain cases where the tawed or imperfectly tanned skins have the plumpness, color, weight, etc., desired, and which would be in other cases secured by means of the first step of this process, the second step may at once be proceeded with, which consists essentially in the fixation of the natural or added constituents of the skins.

It has been found by a large number of practical tests that the action of the natural tannins as introduced into the skin by the first step of this process may be greatly hastened and augmented by the employment of formic aldehyde in conjunction therewith, as accomplished in the second step. Thus with the pyrogallol tannins, a considerable portion of which possess little or no tanning power, a compound is formed

whereby all the tannin available is reduced to, and consequently a greater action secured from a given amount of extract, a matter of importance in point of economy. Again it has been found that by means of formic aldehyde used in conjunction with, but subsequent to the, use of those natural tannins containing "reds", as introduced into the hides by the first step of this process, these substances, which in many instances are insoluble and not directly available for tanning, can be fixed in the leather; and again with other tannins the deposit of whites or bloom is prevented. The peculiar action of formic aldehyde upon the fibers results in filling the skins, plumping them, thereby effecting what is commonly known as feeding the leather.

A special advantage afforded by this process is that is overcomes the obstacles hitherto encountered in the use of material like divi-divi, which add to the leather substances extremely susceptible to fermentation and which lead to loss of leather in damp weather. The superior bactericidal and anti-fermentive properties of formic aldehyde prevent this fermentation and the subsequent softening of the leather. It also prevents moulding during the drying of the finished leather.

Formic aldehyde has the property of fixing the collogen and other gelatinous constituents of the skin in the condition in which they are when subjected to its action; and it has been found to be highly advantageous in using formic aldehyde in the manufacture of leather to prepare the hides or skins by some preliminary treatment of tawing or tanning. They may be alum, oil, chamois, chrome or vegetable-tanned in the first part of the process, and then taken ready prepared and submitted to the fixing action of formic aldehyde.—Patented by Messrs. Dolley & Crank, Philadelphia, Pa.

Leather for Pneumatic Tires and other Special Purposes.

The object of this process is the production of a leather that is exceedingly tough and pliable yet inexpensive to produce, while at the same time it is adapted to many purposes for

which ordinary leather is unsuitable, and more particularly as an armor for pneumatic tires. For this purpose any suitable hide, such as ox hide or cow hide, is employed, and submitted to the following treatment:

The raw hide as taken from the animal is soaked in clean water for a period of three to seven days, next fleshed and limed, and then unhaired. It is next laid for four to ten days, in a pit containing a mixture of alum and egg or other suitable albumen, after which it is in condition to be chemically treated.

The alum and egg-albumen mixture is composed of 56 lbs. of alum, 4 lbs. of egg albumen and 150 gallons of water, and the hide is soaked in this for four days or longer, as circumstances may require. It is then successively placed in each of a series of chemical soaks or baths of graduated strengths, commencing with the weakest, each soak consisting of a combination of sulphuric acid, red arsenic and sumac liquor in suitable proportion. This soaking is continued for two days, during which period the hide is changed every twelve hours from one soak to another of the next higher gradation as regards strength, after which it is placed for two days in a soak or bath consisting of a solution of rubber, petroleum benzine and naphtha. It is then taken out, strained on stretchers or frames and air-dried, after which it is ready for use. The best way to deal with this part of the process is to soak the hide in the benzine and naphtha, and afterward to work or knead into it a solution of rubber. Thus treated, it retains all its natural fibrous and other qualities, has nearly the same flexibility as rubber, is entirely free from grease, so that it will readily receive rubber solution, and is practically impenetrable with ordinary usage.

In treating, say twenty-five hides, the following proportions may be employed for the principal baths or soaks.

The Sumac Soaks.—No. 1. 150 gallons of water, ½ pint of sulphuric acid (specific gravity 1.840), 3 lbs. of red arsenic, 1 cwt. of sumac.

No. 2. 150 gallons of water, 3 quarts of sulphuric acid, 4 lbs. of red arsenic, 1¼ cwt. of sumac.

No. 3. 150 gallons of water, 6 quarts of sulphuric acid, 5 lbs. of red arsenic, 1½ cwt. of sumac.

The Benzine Soak.—12 gallons of benzine; 6 gallons of coal tar naphtha; 56 lbs. of rubber solution of commerce, consisting of Para rubber 1 lb., coal tar naphtha ½ gallon, benzol, 1 pint, and carbon bisulphide ½ pint. Or the rubber may be omitted, and the hides treated separately.

Another Process for Pneumatic Tire Leather.—A process by which chrome leather can be made to retain its flexibility, acquire resilience and become almost punctureless and self-healing, if punctured, has been patented in the United States by Philip Magnus of Collingwood, Victoria. The leather is first cleaned from all impurities or foreign matter and dried. It is then submerged in a cold bath consisting of benzine, 85 parts; benzol, 10 parts; naphtha, 3 parts; kerosene, 5 parts. After submersion in such bath for thirty minutes, the leather is removed and placed, flesh side up, upon a bench and the solution is worked in with a wire or bristle brush. After the first solution has, by the aid of the brush, been caused to penetrate the leather, the latter is again submerged for a few minutes and again brushed. It is then again dipped and brushed and then hung up to allow the mixture that has not been absorbed to drip off or evaporate.

The leather is then ready for further treatment by immersion in baths made of the following mixture: Para rubber, 20 parts; benzine, 80 parts; benzol, 10 parts; naphtha, 2 parts; isinglass, 1 part. The shredded rubber is first dissolved in the benzine, then the benzol and naphtha are added, and finally the isinglass previously dissolved in enough hot water to form a thick, gelatinous solution. The solution of rubber, benzine, benzol and naphtha is divided into three equal parts or baths. One of the portions is the "thick" bath. To the second portion add, say, 10 parts more of benzine and a fractional (⅛) part of naphtha, and call this the "thin" bath; and to the third bath add 10 parts of benzine and ⅛ part of naphtha more than added to the second bath and call this the "thinner" bath. The leather is then treated successively in

these baths, being immersed in the thick bath four hours, in the thin bath about seven days, and in the thinner bath about four days. After each bath the liquid is worked into the leather with a brush as above described, and the leather is hung up to allow for dripping and evaporation of the free liquid. The isinglass mentioned is the purest natural gelatine known and imparts to the leather a soft, tenacious quality. It is dissolved in sufficient hot water to render it gelatinous, as before mentioned, and it is then incorporated with the rubber, benzine and naphtha by mechanical mixture so as to be applied to the leather at the same time therewith.

The leather is finally treated with a third mixture consisting of benzine, 75 parts; benzol, 20 parts; naphtha, 1 part; kerosene, 5 parts, rubbed in with a stiff brush, after which treatment it is hung up and thoroughly dried.

A Process of Finishing Upper Leather.

The leather produced by the following process possesses advantages as regards cheapness, durability, utility and appearance; and particular attention is directed to the inner or flesh side, which is colored a dull blue-black, giving it a distinctive appearance, which is desirable, and furthermore assisting materially in lessening the cost of manufacture.

The process used for the finishing of a calfskin or a kangaroo skin or a hide into leather is as follows: An unstuffed skin or hide, tanned by a gambier, quebracho or other vegetable tanning process, is fat-liquored and dried out. The inner or flesh side of the skin is then colored blue-black by any desirable composition. After the flesh side has been colored, the outer or grain side is dyed black by the application of a suitable dye. After the inner and outer faces of the skin have been colored, the skin is slicked out smooth to set out the grain on its outer or grained face. The skin is then dried in the usual manner, when it is staked and trimmed.

It is then seasoned by the use of bluestone, iron, logwood, ammonia, blood and nigrosine, the proportions being: Bluestone, ½ pint; iron, ⅛ oz.; logwood, ½ pint; blood, 1 pint;

nigrosine, ¼ pint. It is then dried in a warm room and glazed. After it has been glazed it is again staked. It is then seasoned in the same manner as before, dried and glazed again. After the glazing process is finished, the skin is again staked, seasoned, dried and glazed, after which it is ready for market.

The leather finished in the manner described has a highly polished face or grain surface and possesses all the good qualities of leather. It has to a great extent the appearance of patent leather and of glazed kid. At the same time it is soft and flexible and does not crack as readily as patent leather. A patent has been taken out on this method of finishing leather by C. E. and H. A. Lappe, of Pittsburgh, Pa.

A Process of Rendering Leather Waterproof.

The following is given as a process for rendering leather waterproof: A bath is made of about 1 lb. of wax and ½ oz. of oil of mirbane (nitrobenzol), which is an oily substance. After the wax has been melted in a hot water bath over a fire, the oily substance is added and thoroughly stirred in. In this heated bath the leather is immersed for from four to five hours, according to the degree of its hardness. The oil of mirbane has the quality of completely combining with the wax without leaving any fatty deposit on the leather after the leather has been subjected to the second bath. It has been found that oil of bergamot is an equivalent for the oil of mirbane. A second bath, which is also slightly heated, composed of equal parts of alcohol and benzine is then prepared. The leather taken out of the first bath is immersed in the second bath for half an hour. After removal, it is dried in the open air and is then ready for use. The second bath causes the wax to be removed clean from the surface of the leather, and practice has demonstrated that by the process described the wax is retained within the pores of the leather. It is claimed that the leather has increased strength and durability when treated with this process and poor leather is thereby improved in quality. —Patented by Chas. Bohm, of New York City.

A Process of Tanning Fish and Other Similar Skins.

The skins of fishes, sharks, porpoises, whales, etc., require treatment somewhat different from the methods of tanning other skins. A process of tanning such skins that is patented in Europe is described as follows: The salted skins are soaked until they are entirely fresh, then stretched on frames and dried, the rough points being removed by scraping, this relating to shark skins. They are then placed in tepid water until fully resoftened and are beaten on a block. They are then put into a solution of arsenic, 1 part to 200 parts of water, or 1 part of sulphuret of sodium or even half the quantity of each of these substances. The skins are left in this solution for about three days, paddling them twice a day. (For whale skins the treatment with soda and arsenic is not absolutely necessary.) After this the skins are placed in a bath of water and slaked lime in which they are left another three days.

They are next placed in a 1 per cent. solution of muriatic acid and water, stirring them for about five minutes; then they are put into 25 gallons of water together with a half-bucketful of hen dung and 1 per cent. of chemical mordant, and the whole is warmed to about 65° F. After mordanting, the skins are rinsed in lukewarm water and then in a solution of 400 parts water to 1 part hydrochloric acid. Later on they are placed in a tan pit containing the tan liquor, at 5° or 6°, to which is added every three days some tan material until the skins are completely tanned. They are then washed free from acid in a drum; and after that they are turned in a liquor of sumac at 5° to 6° for several hours. They are next washed and may be colored, then fat-liquored with oil. They are now stretched and dried, then moistened and softened, scraped, staked and whitened. Finally they are dressed with a mixture of albumen and water or skimmed milk, after which they are smoothed and given a grain. In case they do not take the grain well, they are immersed for five minutes in a weak sulphuric acid bath.

For tanning, either oak bark or extract answers well, but

various other extracts can be used, such as quebracho, gambier, etc.

To make a sort of chamois leather the following method is followed: The salted skins are soaked and limed, then rinsed in tepid water and dried by rolling them in sawdust. After this treatment they are rubbed with fish oil, pounded and hung up to dry. This is repeated until the skins are completely fulled. After drying, the skins are allowed to stand twelve hours in warm water. They are then washed in a solution of bicarbonate of soda until they are entirely freed from grease, when they are dried, scraped and staked.

When working up shark skins by this method, it is advisable to stretch them in frames and dry them after washing, and then remove the rough points with a scraper. The skins are then placed in lukewarm water until completely resoftened, when they are beaten on a block. They are then placed in a solution of 2 parts arsenic or 2 parts sulphuret of soda, or 1 part of each, in 400 parts of water, leaving them in this solution for about three days, beating and stirring them twice a day. The subsequent treatment is the same as described above.

A Process for Producing Marbled Suede Leather.

The following description relates to a process of finishing the flesh side of leather so that it will have a mottled appearance and a velvety feel. Leather made in accordance with the directions given is soft and pliable and has a velvety surface, which is ornamental and adapted for use in making ladies' bags, for table covers and for a great variety of articles, for which a soft ornamented leather is desirable.

The skins are tanned in the usual way, and the flesh-side is then subjected to the customary preliminary steps that are taken in the ordinary manufacture of suede or velvet leather, that is, shaving and then wet wheeling, or subjecting it to the action of an emery wheel while it is wet. While still wet the skin is laid on a table with the flesh-side up, and puckered or gathered into folds, this being preferably done by hand, and a quantity of dye is poured onto the flesh side.

The exposed portions of the skin will, of course, be exposed to the full action of the dye, while the portions within the folds or puckers will be more or less affected, depending upon the character of the fold. If the fold is a deep one and the sides happen to be pressed closely together, the dye will not penetrate to any extent into the fold and the surface of the leather within the fold will remain practically in its natural condition. Other portions of the skin where the two sides of the fold are not pressed closely together, will be affected somewhat by the dye and will be partially covered, although the color will not be so deep as at the parts entirely exposed. The skin is then dried and the flesh is sueded or run on an abrasive wheel which results in giving it the velvety surface desired. This process, which is patented by Carl Brandt, Norwood, Mass., is especially adapted for use in coloring soft leather, such as chamois.

A Combined Vegetable and Mineral Tannage.

Each of the two methods of tanning by vegetable and mineral processes possesses unique advantages. It has been the aim of tanners to incorporate both sets of advantages in one method of tanning, but hitherto this has not met with much success.

The chrome process gives, for example, suppleness and toughness to leather without fullness or weight, so that any skin that has been chrome-tanned must not be inclined to looseness of texture, for this fault would be accentuated in the finished leather. The vegetable tanning process, on the other hand, gives excellent weight and fullness but lacks the characteristic suppleness and strength of chrome leather. When it is sought to combine these two processes by making one follow the other, it is usually found that the production of one good quality is accompanied by the presence of a corresponding bad quality. For example, if an empty chrome-tanned leather is for the sake of fullness and firmness retanned in some vegetable tanning liquor, these two qualities will be produced, but the toughness of the leather will be sacrificed.

The reverse method of making the chrome process follow the vegetable tannage has met with more success, but even in this case, the final product resembles vegetable-tanned leather much more than chrome-tanned.

According to a French patent, taken out by Klipstein, the two processes are combined so as to run together. For this purpose a vegetable tanning extract, such as quebracho, is mixed with a chrome tanning agent. The following is an example: 125 lbs. of solid quebracho extract are dissolved in their own weight of hot water, and allowed to cool to atmospheric temperature. Sixteen pounds of commercial caustic soda dissolved in two or three times their weight of water are then added, and the mixture is agitated for half an hour, when 150 lbs. chromium sulphate are added. In this way an insoluble tannate of chrome is produced, but on boiling and agitating it changes color to a greenish brown and forms a sulpho-tannate of chrome, which is the combined vegetable and mineral tanning agent.

The tannage is carried out somewhat in the usual way. The skins are unhaired, limed, bated and pickled and are then transferred to a paddle or a drum in which they are tanned with the above-mentioned liquor.

TURKEY-RED OIL (SULPHONATED OIL) IN TANNING LEATHER.

In tanning leather of the various kinds and by the various processes, the use of oil plays an important part and the same has been applied in various ways, though chiefly as emulsion with alkalies or as emulsion containing a free fatty acid. The whole process of tanning can be improved, shortened and simplified, it is claimed, by the inventor of the following described process, by the use of sulphonated oils, or the so-called Turkey-red oils, or alizarine oils. These oils are used in this process of tanning in place of fats or oils, or emulsions of oils and fats, whether in bark tanning, alum tanning, oil tanning or chamoising, or in chrome tanning. The materials present ready means of effecting the proper absorption of oils and fats in the shortest possible time, in the most rational manner and with

a considerable saving of material. Furthermore, the advantages are presented that combinations may be effected that insure the tanning materials being more firmly fixed upon the fibers, resulting in much tougher leather. The benefit derived from the use of these oils is due to the fact that they dissolve in water, contain large quantities of unchanged oil or free fats or fatty acids and present these in a manner to permeate the skins with ease and uniformity, thereby saving material and labor.

The oils or sulpholeates are produced in the well-known way, by the gradual action of 25 to 50 per cent. sulphuric acid upon triglycerides, oil-seeds, etc., as well as upon semi-liquid and fixed fats, with neutralization of the resulting acid-sulpho mixture by means of potassium or sodium hydrate, or ammonia.

A few examples for using the sulpholeates in tanning leather will be given. First proceeding, upon hides to be bark-tanned. The well cleaned and properly swelled hides are placed in a neutral 5 to 7 per cent. sulpholeate solution. After the expiration of a few hours, they are to be taken out, allowed to drip and to dry in the air or in a damp, heated chamber, whereupon after complete drying, they are washed, and the operation is repeated to completion. The remaining oil preparation can always be employed anew, without particular addition thereto. The hide thus prepared and nearly tanned is next placed in a tan vat in the usual manner, or it may be subjected to any other process, as for instance, to a process of quick tanning.

The hide with the usual quantity of tan stuff absorbed is tanned in half the time and is much better in quality and is never brittle. The leather is now treated as usual, and fatted or oiled, though in place of oil, fat or degras, a 6 (greater or less) per cent. sulpholeate may be employed, and finally the hide is dried and washed. The washing, however, may be omitted. Second proceeding: The hides are tanned in the usual manner, and then instead of being smeared or stuffed with fats, oils or degras, they are passed through a 7 to 10

per cent. solution of the oils in lukewarm water, whereupon they are allowed to drip and are then slowly dried. The leather is then at once bark-tanned and may be dyed with finer effect than ordinary leather.

Alum-Tawing with Turkey-red Oils.—The skins tanned by the usual process of tawing have the disadvantage that by water a part of the tanning material is withdrawn from them, whereby their strength is reduced. This evil can be overcome by the application of the sulphonated oils, either before or after the actual tanning with alum and salt. The leather aquires by this treatment increased solidity, flexibility, softness, and a finer appearance. The sulpholeate solutions are admirably adapted to replace the egg yolk used in the manufacture of kid gloves. To the oil solution, according to the French method, some carbolic acid is added, although many other suitable soluble substances, such as salicylic acid, tar oil, etc., may be used to counteract the strong heating of the stuffed skins when sorted away to cure. The sulpholeates may also be used in chrome tanning, resulting in improved quality of leather.

Oil Tanning or Chamoising.—The skins prepared in the usual manner are passed through a 25 per cent. Turkey-red oil solution, whereupon they are allowed to dry and are then laid in a moderately warm room in a heap and covered up. They are next hung up in the air and allowed to dry slowly, when they are again oiled in the same solution after they have been laid in lukewarm water to rid them of any adhering unchanged sulpholeate, are filled, again laid in a heap, again dried and then treated with a solution of alkali. The dry leather is then stretched and rubbed to give it the softness that was lost in drying, and it is then completely oil-tanned.

The results may be variously modified, by greater or less concentration of the oil solution, by higher temperature in drying, also by more frequent dippings. In all cases the absorption of the oil takes place sooner, more evenly and with greater certainty than in the ordinary procedure; and there is no loss of fat because the remainder of the solution may be

applied upon a fresh lot of skins. Combinations with the salts of alumina may also be employed here. The method preferred is as follows: Steep the prepared skins in a solution containing 15 per cent. of the soluble oil; dry them, and if necessary repeat the operation, and then proceed in the usual manner of tanning according to the kind of leather wanted.

A Process of Alum Tawing.

This method has for its object the production of a soft and supple leather by a process of tawing with alum, eggyolk and flour followed by a chrome liquor. The skins are treated in the usual manner to remove the hair or wool, are limed, bated and washed, and made soft and clean. A solution is then made of from 12 to 15 gallons of water to which have been added 9 lbs. of alum, 2 lbs. of salt and 30 lbs. of wheat flour, the whole being thoroughly stirred while at a temperature of 86° F., for fifteen minutes. To the solution are added about 12 lbs. of the yolks of eggs and the solution is stirred for another five minutes. The mixture is then placed in a drum capable of holding 100 lbs. of stock, and then allowed to revolve for from thirty to sixty minutes or until the skins have absorbed the contents of the drum. This completes the first step in the process and what is commonly known as "tawing." The skins are then hung up and dried.

Next a solution of sal-soda is made composed of 1 lb. of soda to 1 gallon of water. In a solution made up in these proportions and in quantity sufficient to treat the pack of goods, the skins are placed until they are soft and flexible and have assumed a neutral condition. They are then washed in lukewarm water to remove all foreign matter and soda, and are next placed in a bath made by adding sulphuric acid to water until the same assumes a density of 1° to 2° Bé. To this solution is added as much of hydrated sesquioxide of chromium or chromic hydrate as will dissolve; and no harm is done when there is a surplus of chromic hydrate remaining in the vessel. Should the solution not be neutral, it may be made so by the addition of sal-soda. The skins neutralized as de-

scribed and afterwards washed, are placed in the chromium solution and the whole is agitated for from five to fifteen hours. The skins are then washed, colored and finished in the usual way. The mordant in the skins, when combined with the subsequent coloring matter, permeates the fiber and adds to the lasting quality and the durability of the leather. This process has been patented by Messrs. A. Warter and H. C. Koegel, of Newark, N. J.

A Process of Improving Poor Leather.

The subject of this patent is a process for producing leather of good quality out of the poorest kind of leather, such as sheepskins or skins of sick animals, as well as from all kinds of leather of flabby structure. This process makes it possible to obtain as desired firm, soft or stiff and even waterproof leather, which will possess softness and firmness. It is well known that the ordinary skins of sheep and sick animals are really, or not at all, suitable for shoemaking, because they have a very loose structure and a grain that is not suitable for the purpose for which the leather is used. Such skins are also apt to stretch and tear like paper. It is also known that split leather is treated with celluloid and castor oil for the purpose of giving it the appearance of grain leather, and the coating makes the leather waterproof without further treatment.

With the present process, however, split leather is not employed, but grain leather of poor quality is converted into serviceable leather, not by coating it with an impermeable dressing, but by using a substance that sucks up the particles of water and grease which penetrate into the structure of the leather, where it acts as an absorbent of the vapors or sweating of the feet. By the addition of sulphur or sulphur chloride, the mixture of celluloid and castor oil acquires the property of absorbing water and oil particles.

With this process badly tanned skins can be utilized. Preferably they are first tanned, then colored, and after drying are placed for a few minutes in a bath of elastic composition,

which maintains without changing the same high or low temperature as the tanned fibers of the leather, by which means the leather retains its property of absorbing water or grease particles; it is given the make-up of good leather; the grain does not warp and is made stronger; the leather becomes firmer and more durable.

The impregnating compound is composed of cotton wool, camphor or cellulose or celluloid waste, with oil and sulphur or sulphur chloride, or of a mixture of these and similar substances, dissolved in volatile or other suitable material.

An excellent compound is made by mixing amyl acetate, 2000 parts; celluloid waste, 10 to 100 parts; castor oil, 200 parts; sulphur chloride, 5 to 50 parts (or from 2 to 20 parts sulphur added with heating). After immersion in this bath the skins are slicked off and dried quickly, in at the most 120° F. of heat. In some cases they are afterwards further dried in the air. When fully dry, the superfluous composition is scraped off the surface, and oiling and dressing are done in the usual way. Any desired grain can be given the leather so prepared. The process requires no special apparatus. It has been patented in Germany.

A Novel Method of Tanning.

In all the rapid tanning processes heretofore in use, for which concentrated extracts are employed, it has been a necessity to keep the skins, while in the tan liquor, constantly in motion. This mechanical movement requires expensive apparatus which has the drawback of causing more or less damage to the skins while being tanned. The object of the following process is to get rid of that drawback, while at the same time using concentrated extracts, thereby effecting not only more rapid and sure tanning of the skins, but also an improvement in the quality of the leather produced. In carrying out this process, the skins are limed, bated, etc., in the customary manner, and are pressed and made absolutely neutral. They are then treated with the tanning extract. The liquid extracts on the market can be used without thinning out. The skins

are laid in piles and then doubled over in halves so that the head and tail come together. The liquid tan extract is brushed over the upper surface of the half of the under skin, which is then turned over, and the other half brushed in the same way. The second skin is next treated in the same way, and so on until the pile is completed. The skins are then left to stand until the tan extract is absorbed, and the second coating of extract is given in the same way, the operation being repeated until the skins are fully tanned. If this tanning is effected in a tank all superfluous tan liquor is drawn off. Instead of liquid extracts, dry powdered extract can be used, sprinkling it below the doubled skins. Absorption of the dry tan extract is assisted by the moisture of the liquid extract; and the leather has great denseness and firmness. A practical description of this process is here given.

The skins are first treated with a diluted solution of formic acid and then washed with plenty of water. They are then placed in a weak, slightly acid tan liquor, in order to induce the formation of calcium tannate. They are again well washed and placed under a pressure of 80 atmospheres, by which they are rendered absolutely neutral. They are next opened out and placed in a trough and the tanning extract is applied. About a pound of extract at about 25° Bé., is used for each pound of hide, that is, about 60 lbs. of extract for a hide of the same weight. The extract is applied to both sides of the hide with a brush, the superfluous extract being allowed to run off. This treatment is repeated three times a day for eight days and after that twice a day. A hide of average weight and thickness will require about twenty days to tan fully; heavy hides require from twenty-five to thirty days.—Patented by G. Durio, of Turin, Italy.

A German Process of Tanning with Formaldehyde.

By the application of the following process of tanning to hides or skins, a leather is obtained that will not lose its tannage through the action of hot water nor of sweat, that is very tough and resistant to tension, being especially adapted

for orthopedic and surgical uses, such as belts, straps, linings, envelopes, gloves, and even for saddlers' and shoemaking purposes.

The leather is prepared by a combined tannage of formaldehyde, grease or oil, and a watery emulsion containing magnesium silicate. This emulsion contains the active parts in extremely fine divisions, in order to favor as much as possible the contraction and binding of the surface. The skins are prepared in the usual manner of liming, bating and washing, and are then placed in the drum together with the emulsion, which must be sufficient in quantity to cover them.

The tanning can also be done in stationary tanks but then takes more time. At the beginning the emulsion is composed preferably of 20 per cent. oil, 5 per cent. talcum and ¼ per cent. formaldehyde. First a durable fat emulsion is prepared, for which any of the water-soluble (sulphonated) commercial oils may be used. To produce the best leather, vegetable oils are employed; but castor oil must be used with caution as only the cold-pressed oil is free from the poisonous resin. The addition of gum tragacanth or similar binding substances in the emulsion is not absolutely necessary, if care is taken to neutralize the small percentage of free oleic acid present in the oils, by adding about ten drops of soda solution to each quart of the emulsion. From once to twice the quantity of formaldehyde given above is added in the course of the tanning as may be required. The length of time required to tan the skins depends upon their thickness. Several days are required for thin leathers where stationary tubs are used; thick skins require from two to three weeks. Where a drum is used, thin skins can be tanned in twenty-four hours.

All kinds of skins can be tanned by this method; and it can, either before or after tanning, be used in combination with any other tannage. Leather made by this process differs from chamois in its color and greater strength, and it does not shrink even after repeated washing.

The leather, which is similar in appearance to tawed leather, maintains, even when three sixteenths of an inch and more in

thickness, perfect pliability and suppleness, together with great firmness, which enables it to fit itself directly to the parts of the body over which it is worn.

A Method of Degreasing Skins.

The degreasing of skins is at the present time carried out in two ways, either by means of organic solvents, such as benzine, carbon bisulphide, carbon tetrachloride, or by means of an alkaline liquor, such as carbonate of soda, soaps, etc. The first class of methods has the disadvantage that the solvents are extremely inflammable, and therefore there is danger of explosion and fire. Moreover, it is stated that they exert a harmful action on the skins. Some of them, such as carbon tetrachloride, decompose it easily. Finally the degreasing operation and the recovery of the solvent, necessitates a complicated plant, consisting of distilling apparatus. The second class of methods degreases only incompletely and the greases are only partially recovered. According to a French patent of M. J. Filhol, another sort of process is used. It consists more especially of the use of tetrachloride of ethane. This tetrachloride can be replaced by other products, but they are not as serviceable. When greasy skins are treated with ethane tetrachloride either alone or with water at a temperature between 35° and 40° C., (95° and 104° F.) the grease rapidly passes into a state of colloidal solution. This liquid, separated from the skins, permits the grease to coagulate on cooling, this property allowing the easy separation by de can tation and filtration of the greases from the liquid solvent, which can, however, be recovered in an extremely simple manner. Tetrachloride is completely noncombustible, is easily recoverable by mere filtration, and has no harmful action on the skins, which it degreases completely.

The operation can be carried out on skins in the pelt form. The tetrachloride intimately penetrates into the tissues and facilitates the tanning process. It is useful in carrying out the process to avoid exposing the solvent to strong light. The following is an example of the method: Ten dozens of sheep-

skins are placed in a special form of drum and 20 kilos of tetrachloride are introduced along with 80 liters of water, which is heated to 40° C. (104° F.) and the whole is turned. At the end of two or three hours, according to the amount of grease present, the liquid is emptied into a decantation vessel, in which it is allowed to cool.

The grease coagulates and rises to the surface produced by the separation of the water and the tetrachloride, which of course are superposed in the order of their densities. The water is decanted off and the grease separated. The remaining liquid is passed through a filter press, the filtering surfaces of which are moistened. The grease is thus separated and the liquid can be utilized in the drum for another process. The skins thus treated are washed in tepid water with the addition of formaldehyde or of common salt. This liquid is decanted and filtered as before.

The Manufacture of Intestinal Leather.

This process has for its object the production of a leather from the intestinal membrane or coat, that on being bleached has the appearance of ordinary glove leather or kid. It is, however, essentially distinguished from such leather by the absence of pores, thus rendering it impervious to moisture and gases, and by its extreme thinness coupled with great toughness or strength of fiber. It is distinguished from gold-beater's skin by that it may be sewed, the seam being firm and the leather closing tightly around the thread, and also by its extreme pliability and softness. The properties above stated render this leather peculiarly suitable for the manufacture of gloves for those whose occupations render it necessary to effectively protect the hands against infectious matter and poisonous solutions, the extreme softness permitting free movement of the fingers and its thinness giving the sense of touch full play. Unlike the gold-beater's skin, it may be boiled without injury, so that a surgeon's glove made from it, may be dipped into a formaldehyde solution and then boiled for the purpose of cleaning, disinfecting and sterilizing it. This is a matter of great importance.

This leather is applicable to a great variety of purposes in the useful and fine arts. For example, it is exceedingly well adapted for ink ribbons. As a covering for balloons for signaling, for military and other purposes, it has been found superior to the ordinary silk covering by virtue of its greater lightness, less bulk, pliability, softness and imperviousness. It can be dyed any color. When dyed, it may be used in place of ornamental papers. As a starting material, serves the outer peritoneal coating of the caecum or blind gut of the ox, the same substance which is used as gold-beater's skin in the making of goldfoil. In most of the slaughtering establishments in the United States and in Germany, this membrane is now removed from the intestine which it envelops and is supplied in this condition to the manufacturers of gold-beater's skin, or to gold-beaters.

In order to convert this delicate membrane into leather, first remove all fatty substances and adhering impurities therefrom by the following treatment: The membranes are first rinsed in warm water, preferably in three graded baths, each having a higher temperature than the preceding one. Best results are obtained by making the temperature of the first bath 25° C., that of the second 30° C., and that of the third 35° C. (77°, 86° and 95° F.). The membranes are next immersed, and left for about five minutes, in a bath composed, for 100 membranes, of 10 grams permanganate of potash dissolved in 3 liters of water and having a temperature of 80° F. They are then placed in a bath of 20 grams of sulphurous acid dissolved in 3 liters of water at 80° F. In this bath the skins must be left until they have swelled up and attained a pure white color, whereupon they are taken out and again submitted to three rinsings in warm water as above. They are now ready to be immersed in a soap solution or bath, which is preferably prepared by boiling about ½ kilogram (1.1 lbs.) of good pure white toilet soap, such as white castile coap, in 1½ liters of water, for 100 membranes, the temperature of this bath having been first reduced to 95° F. by the addition of ½ liter of cold water. In this soap bath the membranes remain

for several hours, until the soap has been completely absorbed; they are then put successively into two baths of warm water having a temperature of 80° F., for the purpose of completely washing them. The membranes are now ready for the tanning process, which is as follows: A solution is prepared by dissolving for each 100 membranes 100 grams of chromic acid and 50 grams of alum in 1 liter of water at 95° F. The membranes are placed in a bath of 1 liter of warm water of 80° F.; the chromic acid solution is gradually added to the water, the skins being stirred about in the bath. Preferably the following course is pursued: First, about $\frac{1}{8}$ of the chromic acid solution is added to the membranes, then after about ten minutes a further $\frac{1}{8}$ of the same, and after a further ten minutes $\frac{1}{4}$ of the original amount of the chromic solution, and finally after twenty minutes, the rest of the chromic solution is poured into the bath containing the membranes. In this final bath the skins are allowed to remain for one hour, being constantly agitated or stirred. They are then removed from the bath and rinsed twice with warm water of 80° F. This completes the tanning process.

It is advantageous to immerse the tanned membranes in a bath composed of 500 grams of yolks of eggs and 100 grams of glycerine added to 2 liters of water and thoroughly mixed with it. The membranes remain in this bath about ten hours. They are then removed and drained by hanging over ropes and next placed on suitable frames and allowed to dry. After they have thus lain for about eight days they are stored in moderately damp chambers or inclosures, and are then drawn over their entire surface over crescent-shaped blunt knives until they are smooth and pliable.

The leather is now finished and may be used in this condition, but for many purposes it may be found desirable to further finish or embellish it. It may be dyed beautiful colors, and for this purpose may be immersed in a bath containing the desired dye, such as aniline dye, in quantities governed by the color to be imparted. A bath containing from 3 to 5 per cent. dye usually answers. To this bath a

mordant consisting of 4 cubic centimeters of acetic acid of 50 per cent. strength is added. In a bath so prepared the leather remains several hours. Further, it is claimed that by this process the leather, whether dyed or undyed, may be still further finished by passing it through calendering rolls. In some cases colored talcum powder may be sprinkled or dusted over it, and it be then calendered. It is also desirable in some cases to coat the undyed leather with a thin film of a composition prepared by mixing 8 parts collodion, 1 part castor oil and 1 part caoutchouc solution. Leather so coated is suitable for gloves, accordion bellows, and the like. When it is desired to obtain a thicker and stronger leather, which, however, is not so well adapted to be dyed, a tanning bath consisting of 100 grams of sulphate of zinc, 40 grams of alum and 50 grams of wheat flour properly mixed with 1 liter of water may be used to tan 100 membranes, the other conditions and steps of the process remaining the same as above. This tanning bath is used instead of the chromic acid bath described above. This treatment yields white, lusterless leather of greater body than that produced by the chromic acid method. This process is patented by Bruno Trenckmann, of Berlin, Germany, who also has a patent on the following described process:

Manufacture of Parchment-like Skin.—In the process as usually carried out, the peritoneal membrane of the gut, after having been cleaned of fat and soaked in a bath of soap, is immersed in a bath of sulphate of zinc, chloride of barium or any other similar mineral salts which are able to produce pigments insoluble in water, by double transposition with any organic salts, acids or bases. This process consists of alternately treating the skins in such baths at certain definite temperatures. For example, the gut membranes are first rinsed from five to ten minutes in a solution of sulphate of zinc or other mineral salts of 15° Bé. and at a temperature of 40° F. They are then put into a solution preferably of carbonate of sodium of about 15° Bé. and at the same temperature, and are treated therein for about the same period of time, raising the temperature to 60° F. They are then returned

into another solution of sulphate of zinc, and then into a solution of carbonate of soda. This treatment is repeated once or twice more until the skins have absorbed a sufficient amount of the pigment, which is usually attained after two or three treatments.

By this process a parchment-like, clear white, or well colored, product is obtained, which may come into contact with water and when again dry will appear as before. The product is capable of being extended when soaked and will again shrink while drying, thus making a tight cap, perfectly airtight, so desirable for closing bottles of all kinds.

Leather for Organ Pipes.

Leather made by the following process is distinguished by its fineness, suppleness, lightness and durability, such properties being required for many industrial purposes, particularly for lining organ pipes, and in the manufacture of bellows and the like, and generally for purposes where it is desired to have an airtight, light and flexible material. The leather hitherto used for such purposes was usually not absolutely airtight or sufficiently flexible, while rubber sheets or fabrics impregnated with a solution of rubber, although airtight, are very difficult to fit snugly, because they are not sufficiently soft. They have, besides, the serious drawback of being liable to deteriorate and lose their flexibility, thereby becoming brittle under the influence of cold. This is of great importance in the case of organs in churches which are not heated during the winter. This leather obviates all these drawbacks, and is therefore suitable for various purposes. It is manufactured from the caecum or blind gut of the animal. This outermost skin of the blind gut has hitherto been deprived of its fat and dried, and used as the so-called gold-beater's skin. It has been proposed to subject it to a tanning process, but the leather obtained in that way alone is not sufficiently airtight and durable.

According to this process, the blind gut skin, well cleaned and washed with potash or the like, is first tanned by means

of mineral substances, such as chrome alum, etc., or with vegetable substances. In practice it has been found that for 200 skins of maximum size, 400 grams of zinc sulphate with 10 liters of water are suitable as a tanning solution, or about the same quantity of chrome alum may be used. The skin is then filled in a bath of yolks of eggs, flour or the like, and permitted to remain until it is thoroughly impregnated, whereby it is made thicker and stronger. This bath is made by adding to about 1 liter of yolk of eggs a small quantity of flour. The skins are then rinsed, stretched and dried. The drying is effected by placing two skins, one on top of the other, and allowing them to dry together in intimate contact. During this drying process they firmly adhere to each other without any glue or cement being used. The best plan is to place the grain or outermost sides of the two skins against each other. More than two skins may be superposed, in which case the similar sides are placed in apposition.

When a multiple skin treated in this manner has become sufficiently dry it is degreased or deprived of its fat by treating it with benzine, it being at the same time rubbed and kneaded in it, whereby it is rendered soft and supple. This treatment is necessary to remove the oil incorporated in the skin by the treatment with the eggs and to make the leather soft and capable of being cemented to wood and metal. This property renders it suitable for gluing or piecing together, so that large pieces of any size may be made from small pieces, and it can be cemented to other materials, such as wood, etc., which is of importance for organ pipes and other purposes. This process, as stated, includes the process of tanning the stock, but if untanned skins are subjected to the other steps of the treatment—filling, superposing and washing with benzine —a product is obtained having many advantageous characteristics over the untanned skins previously known.

Tanning with Alfalfa Extract.

In this process of tanning, alfalfa and gambier are used. The tanning compound is composed of extract of alfalfa, 30 gallons; gum gambier, 10 lbs.; salt, 2 lbs.

The extract of alfalfa is obtained by boiling 8 lbs. of alfalfa seed or 50 lbs. of alfalfa hay in 50 gallons of water until the liquid has been reduced to 30 gallons, which will be of the necessary strength. The gum gambier and salt are dissolved in the extract to complete the mixture.

The hide is soaked, limed and unhaired and washed to free it from lime. It is then dipped into the tanning mixture until it is a uniform color, after which it is removed and oiled on both sides with neatsfoot oil, then worked until it is dry. It has been found, says the inventor of this process, that by following the method that has been described, from 75 to 100 lbs. of leather can be tanned in from three to twelve days at a cost of less than three cents per pound, the time necessary for completing the tanning being reduced by reason of the fact that the alfalfa opens the pores of the hide and permits the compound to saturate the hide more rapidly. The above tanning compound has been patented by John H. McWhirter, Grand Valley, Oklahoma.

Some Patented Processes of Bating and Deliming.

Bating with Sulphonated Oil and Sal Ammoniac.—This process consists of deliming hides and skins in a bath consisting of sulphonated castor oil and sal ammoniac. After the hides or skins have been limed, fleshed and washed, they are treated with this bating process to be freed from lime, softened, swelled and purified and made receptive to the tanning material. The bating bath is as follows: For 2000 lbs. of limed hides or skins, use a suitable vat or paddle, and run into it approximately about 750 gallons of water, to which add 20 lbs. of sulphonated castor oil (Turkey-red oil) and 10 lbs. of chloride of ammonium (sal ammoniac). Raise the temperature of the bath with steam to 110° F., and put in the limed hides or skins.

In practice it is found that about 1 per cent. of the weight of the skins of the soluble oil mixed with about ½ per cent. of the weight of the skins of sal ammoniac, when diluted with water enough to cover the stock and raised to the temperature

above stated, will rapidly effect the conversion of the lime contained in the hides or skins into soluble lime solution or calcium chloride. Coincidently the fatty acid of the soluble oil is set free and is absorbed in such a manner by the skins as to swell and make them porous, and also neutralize any adhering lime that may remain in the cellular tissues and may not have been acted upon by the free ammonium chloride in the bath. After the limed hides or skins have been placed in the bath, they should be stirred about or drummed in the usual manner for about one hour, although they will not be injured by being left in the liquor for a longer period of time. In every case they should be left in it long enough to become soft and thoroughly delimed.

A cold bath may be used but a longer immersion is required. To expedite the process a temperature of from 105° to 115° F. has been found desirable. When sufficiently reduced and free from lime, the skins may be immediately placed in the tanning liquors. The bate bath can be used continuously for some time by adding fresh, but less, material as the liquor increases in age and strength. It is claimed for this process that it thoroughly delimes the stock without affecting its natural fiber and strength, and that after passing through the subsequent tanning operations, the leather is stronger and superior in quality to that bated by the older fermentation processes.

Bating with Bichromate of Potash.—The gist of this process lies in the employment of a chromium compound as a base, a solution of it forming the main ingredient of the bate.

Prepare a saturated solution of 2 ozs. of bichromate of potash in water, pour it into a vat containing 1000 gallons of water and stir thoroughly. The quantity named is sufficient for from 20 to 40 hides, which are thrown into the prepared bate and left therein for twenty-four hours, being stirred about occasionally. The temperature of the bath should be about 80° F. The hides may be run in the liquor a short time and then left in it over night or longer. They are then fine-haired, washed in warm water, and are then ready to be

tanned. About 2 ozs. of bichromate of potash are used for 2000 pounds of hides or skins, green-salted weight. The use of bichromate of potash as a bate has been patented by Henry Schlegel, of Lepeer, Mich.

Bating with Sulphuric Acid, Glauber's Salt and Borax—A process of bating with a compound solution of sulphuric acid, borax and Glauber's salt has been made the subject of a patent. In applying the solution, the hides or skins, after liming and unhairing, are placed in a paddle partly filled with 5 or 6 barrelfuls of water to which a solution of 3 lbs. of sulphuric acid, 3 lbs. of borax and 3 lbs. of Glauber's salt has been added. This is sufficient for 150 hides or skins. Five hours in a paddle reel will be sufficient for the liquor to delime the hides.

After the treatment of the hides in the solution above described, they may be placed for second treatment in an ordinary bark liquor to which have been added 3 lbs. of muriatic acid and 50 lbs. of salt. The quantity of bark liquor is about 1000 gallons of 6° Bé. The addition of the muriatic acid and salt serves to precipitate all foreign substances in the bark liquor and to prevent any fermentation thereof, and the action of the ingredients in the solution so formed is to soften the hides soaked therein and to render them more plump. This method of treatment in a solution of water, sulphuric acid, borax and Glauber's salt for neutralizing the lime in the hides may be used without the treatment with bark liquor, acid and salt; the hides may also be treated to the action of the latter solution without submitting them to the action of the first named liquor for the purpose of neutralizing the lime. Patented by N. Wilson, Beckett, Mass.

Bating with Glucose, Sulphur and Yeast.—In working with this process, the skins are limed, unhaired and washed. A bath at 95° F. is next prepared, consisting of 5 per cent. glucose syrup and 1 per cent. sulphur, computed on the weight of the skins, and about 1 lb. of yeast for every 1000 lbs. treated. The bath prepared in this manner is allowed to stand twenty-four hours to become thoroughly fermented.

At the end of this time the temperature of the liquor is raised to 100° F., and the hides or skins are put into it.

In order to have a continuous bath, one-half the original quantity of sulphur, glucose and yeast is added at the same time. In working this process it is not necessary to keep the skins constantly in motion, but only to stir them about occasionally. Heavy hides will be free from lime and in soft and open condition at the end of eight hours; lighter skins in a proportionately shorter period.

On removing the pack, the temperature of the bath may be raised, and after adding one-half the original quantity of sulphur, glucose and yeast, another pack may be treated, thus making it possible to work two packs each day in the same vat. It will be understood that a continuous bath would in time become too concentrated from solutions of calcium compounds and thus prevent or retard fermentation. This difficulty is obviated by drawing off half of the solution every time after treatment of the second pack.

The hides or skins show no trace of lime after treatment. They are soft and open and have smooth, silky grain. As there is nothing in this bate to cause putrefaction, there is no loss of hide substance and the skins without further drenching, can go at once into the tan liquors. Where pickling is part of the process the skins can be pickled at once and then tanned. This is the Oaks patented process of bating.

Bating with Dog Dung.—Despite the unpleasantness of its use, dog dung is an efficient bate for leather that requires a soft, fine and silky grain. The material may be used alone or combined with the droppings of hens and pigeons. If dog manure is kept for some time it becomes heated of itself, burns up and becomes useless. Consequently it is placed in barrels, covered over with enough water to soften it, and allowed to ferment for two weeks or until it has resolved itself into a pasty condition. It can in this way be kept for months in covered barrels without losing any of its bating action.

When it is to be used, it is stirred into boiling water (by this means a great many of the bacteria are killed but not the

spores) until after decanting off several times all the soluble matter has been removed and only the waste portion remains behind. But all sand must be allowed to settle out again from the liquor, since if any of it is allowed to remain, it is likely to injure the grain; this settling takes place to the best advantage in a large vat.

For 100 pieces of calfskins, it is customary to reckon about 10 to 12 quarts of dog dung; while for 30 dozen sheepskins about 50 lbs. of the material are used; and for 1000 lambskins 100 lbs. or more is the quantity required. The proper amount of the bate is placed in the paddle wheel in water sufficient for the pack of skins to be treated. At the beginning the temperature of the liquor should be about 90° F. The skins should remain in the bate for from two to three hours, or at the longest, until the flesh remaining on them can be readily removed. It is injurious to the skins to bate them too long.

After the process is completed, it is well to rinse off the skins and then to place them at once on the beam or the fleshing machine. By placing them in fresh water the flesh becomes tender and is not removed as readily as when it is in the mellow condition in which it comes from the bate; consequently as little water as possible is used so that the mellowness of the skins is not lost.

In this process of bating it is easily possible for undesirable fermentation to take place and to injure the skins. The duration of the bating in a normal case should occupy a definite time regulated by the temperature, strength of the liquor and texture of the skins, as well as by the degree of fermentation which the bate has developed. This method of bating is not patented.

Bating with Molasses.—Sour molasses makes an effective bate for hides for heavy leather. The molasses is soured by putting 7 gallons of it into a barrelful of water, adding 1 gallon of milk to assist the souring, keeping the solution at 90° F., and stirring it occasionally until it is sour. More than one barrel is required, so that more molasses can be souring while the first is being used.

To use the sour molasses, fill a paddle wheel with enough water to cover 50 sides and add to it 8 pailfuls of the sour molasses. The sides remain in the bate at least thirty minutes, and a longer bating will do no harm, although there is always danger of bating too low. Judgment must be used as to how long to continue the process. When the bate becomes weakened by the lime which works out of the hides, more sour molasses should be added, say 6 pailfuls to 200 sides. If the paddle holds 50 sides put in 1½ pailfuls of molasses after taking out each pack of hides, and keep the temperature of the bate at about 80° F. The bate should not be made fresh for each lot of hides, but molasses should be added to it. When the bating is over, withdraw the hides and rinse them in cold water in another paddle wheel for a few minutes, and then put them onto sticks for the tanning liquors. The bated hides will contain considerable lime but a few hours in the liquor will take it all out.

After the liquor has been run through the yard from the head handlers to the tail handlers or rockers, the liquor in the tail handlers will be very weak, containing less than 1 per cent of tannic acid, and quite a little lactic and acetic acids, which soon takes the lime out of the hides and plumps them. A little lactic acid, say 3 quarts, added to the prepared bate liquor, will help considerably in effecting a removal of the lime from the hides. The processes of bating with molasses, Dermiforma and bran are not patented.

Bating with Dermiforma.—Dermiforma is a prepared bacterial bate that has been introduced as a substitute for the old-time bates. The methods of using it described below have proved satisfactory and the results desired have been obtained.

It should be borne in mind that bacteria are governed by different temperatures, and if it is desired to reduce or deplete the hides or skins, the temperature of the bating liquor should be kept as near as possible to 95° F. during the process. Experience has shown that a different grain is obtained at different temperatures; consequently if the liquor is as nearly as possible kept at the above-mentioned heat during the pro-

cess, the skins will be reduced more quickly and the grain will be finer. This applies to all classes of stock. The quantity of Demiforma to be used for every 100 lbs. of skins varies.

In the bating of goatskins 4 lbs. are used for each 100 lbs. of them to be bated, the same quantity being used in bating calfskins. Sheepskins, however, may be bated with 2 lbs. to each 100 lbs. of them, and the same quantity bates hides and kips, while seal skins require 3 lbs. of the bate for 100 lbs. of them.

It usually requires about four hours to get calf, seal and sheepskins in condition to be pickled or tanned. It requires good judgment of the operator to determine the exact time for the bating process; consequently no general rule can be laid down as some tanners do not bate hides longer than two hours at 95° F. If it is desired to plump the stock, 1½ lbs. of the bate will be sufficient for 100 lbs. of it, the time required being generally from two to four hours, and in some cases where hides are being plumped for sole leather they may remain in the liquor over night. The temperature should be normal or not over 80° F.

In using Dermiforma in tanning liquors, either sweet or natural sour liquors, 1½ lbs. to every 100 lbs. of green hides will plump them, and the leather will gain in weight. Where extract liquors are used entirely, the result is greater and the tannage more rapid with the above proportions. In all cases the hides must be thoroughly washed from the limes or the proportions given will not answer. When an excess of free lime is carried into the bating process more bate is required.

Bating is done most advantageously in a vat with paddles, and not in a stationary tub, as the action of the paddles causes the liquor to be stirred, thus more quickly accomplishing the deliming of the skins. A warm bate depletes or reduces the goods; a cold bate plumps them. When deliming is completed and the skins are soft and silky to the touch, they should be removed from the bath, rinsed in warm water, and then be either pickled or tanned. Skins are bated most satisfactorily in warm liquor while for hides for plump and heavy leather a cold bate is best.

Bating with Bran.—Deliming skins with an infusion of sour bran is one of the older methods of bating and one that is still in common use. The following process will be found satisfactory: Add enough water to a half-barrelful of bran to make it mushy, cover it up and let it stand forty-eight hours, or until it has become thoroughly sour. This quantity of bran is sufficient for from 400 to 500 skins according to their size and thickness. The sour bran is emptied into a suitable vat half filled with water and having a paddle wheel, and 3 pints of sulphuric acid and 3 pecks of salt are then added and the mixture is thoroughly stirred and heated to 90° F. Throw the skins in as quickly as possible and keep the paddle running for four hours or until the goods are soft, clean and free from lime. Light, thin skins of course require less drenching than thick, heavy stock.

If the skins are to be colored, it is advisable to work the grain out as clean as possible, and then to rinse them in warm water and pickle them. For black leather the working-out can be omitted, the skins being simply rinsed and pickled. The drench can also be prepared by using the following proportions: Soak 50 lbs. of bran in warm water until it is sour. Then stir the same into 700 gallons of water in a paddle vat and add 10 lbs. of sulphuric acid. Plunge the drench thoroughly; warm it to 90° F., throw the skins in and drench them until they are soft and clean. Then work the grain out as clean as possible, rinse the skins and pickle them. The active deliming agent of the bran drench is the lactic acid that results from the fermentation of the bran. Many tanners and wool-pullers prefer the use of commercial lactic acid to the bran drench, it being soft, clean and certain in its action and effect.

A Quick Waterproof Tannage.

The hide to be tanned by this process is soaked in cold water for one and one-half days, then immersed for three days in a concentrated solution of sodium sulphide and lime, each testing 40° barkometer, at a heat of 110° F. The hide is

then shaved and placed in clear cold water for twelve hours, removed and placed in a composition of cutch extract, ten pounds, and chestnut extract, ten pounds, and water, to test 25° barkometer each, from which it is removed and placed for three days, in a bath of oil of vitriol at 30° barkometer, when it is placed for twelve days, in a bath of cutch and chestnut extract each testing 25°, the strength of the bath being every third day increased ten degrees. Remove and place in a soda-ash bath of 25° at 126° F., for fifteen minutes; remove and place in oil of vitriol at 30° barkometer at 130° F., for five minutes then in clear cold water for one-half hour. It is then placed in the dryhouse for five days, at a temperature of 145° F. Paraffin, 1 lb.; yellow wax, 1 lb., and fat suet, 2 lbs. are heated to 130° F.; mixed thoroughly and brushed onto the leather. After a thorough brushing the leather is placed in the dryhouse at 110° F., for ten hours. After it is thoroughly dry, place it for fifteen minutes in soda ash solution testing 25° at a temperature of 126° F., next for five minutes in oil of vitriol testing 30° at a temperature of 130° F., then in cold water for three hours, when it is again thoroughly dried and then rolled on the rolling machine. After the first rolling, brush over quickly with oxalic acid and again roll. After the second rolling place it in the dryhouse for twelve hours, after which it is ready for use. Patented by Joszyp Moszynski, of Philadelphia, Pa.

A Gambier and Salt Tannage.

The tanning composition of this process consists of 83⅓ per cent. of gambier and 16⅔ per cent. of common salt, and to each 5 lbs. of gambier used 1 lb. of Epsom salts is added. These quantities are for a single hide. When more than one hide is to be tanned, add for each extra hide one-half of the specified quantities of ingredients.

For tanning the skins of calves, sheep, goats and deer, for a single skin 1½ lbs. of gambier are used with an amount of salt equal to 16⅔ per cent. of the whole mixture. The gambier and salt are dissolved separately in 3 gallons of hot water,

the gambier being dissolved in a brass vessel which will not be affected by the chemical action of it. The dissolved salt and gambier are then mixed together and the Epsom salts added. The skin is immersed in the liquor so prepared and allowed to remain from two to four days, when it will be found to be perfectly tanned. From 1 to 3 lbs. of gambier are used for each hide of a yearling, and from six to ten days are required to complete the tannage. For heavy hides 7 lbs. of gambier are used with a quantity of salt equal to 16⅔ per cent. of the total amount of salt and gambier used, 6 gallons of hot water being employed in this composition. After the mixture has been prepared the hides are allowed to remain from fifteen to twenty-five days, which time is necessary to tan hides of this character. It is claimed that this process, which is patented by Martin B. Larson, of Molson, Wash., makes soft and tough leather quickly and at low expense.

A Process of Salting Hides to Prevent Salt Stains and Loss of Weight.

Immediately after removal from the carcass and before tanning, in order to prevent decomposition and loss of substance, hides are sprinkled with common salt, and it is frequently found that stains are produced by such treatment. Moreover, it is known that when the salt is subsequently washed out, a certain loss of hide substance takes place. Some experimenters have endeavored to prevent the formation of salt stains by the addition of an antiseptic such as zinc chloride or mustard oil, since the stains were considered to be due to the action of bacteria, though certain observers suggested that they arose from the hemoglobin of the blood. Others have suggested the addition of borax, which apparently prevents stains, but causes a slight, generally, blue coloration of the whole mass. Where borax or more powerful antiseptics, such as sodium fluoride, mustard oil, etc., are employed, however, there is still the loss in hide substance when the salt is washed out. It is the object of the following method of treating hides before tanning to overcome these disadvantages and to prevent the

formation of salt stains. It need scarcely be pointed out that if it is possible to prevent a loss of from 2 to 4 per cent. of hide substance, the process would be of great commercial importance since it would yield a greater weight of better product. The inventors of this method of treatment made extensive experiments during both winter and summer months with large quantities of hides, and they claim to have succeeded in eliminating the causes which underlie both the above-mentioned phenomena. They discovered that staining can be prevented if bacteriological decomposition is inhibited simply by the exclusion of water and salts containing water of crystallization instead of by the addition of antiseptics. It is well known that ordinary commercial salt contains considerable quantities of such salts, especially sodium sulfate and certain calcium and magnesium compounds. Secondly, it has been found that the loss in weight of hide substance can be reduced by excluding salts containing water of crystallization and calcium and magnesium compounds. Sulfate of sodium in particular causes the liberation of free sulphuric acid in the hide substance, which is an amphoteric colloid.

It has been found that sodium sulfate forms a very soluble alkali hide substance which causes the loss in weight. In addition to the above two points, it has been found that if, instead of adding antiseptics, the above-mentioned impurities are excluded, the appearance of the leather is improved apart from the salt stains. This improvement has been found to be due to the avoidance of the formation of calcium and magnesium compounds soluble with difficulty with the albuminoid matter of the hide colloid, and also to the avoidance of the formation of the insoluble soaps with the fatty matter contained in and adhering to the hide.

According to this invention, therefore, the inventors remove substantially all the impurities from commercial common salt by the process patented by them in Great Britain, which succeeds in producing a product containing 99.99 per cent of sodium chloride. They then treat the hide immediately after removal from the carcass, with about 15 to 20 per cent. by

weight of such chemically pure salt in the dry and very finely divided form. The salt in this condition is readily taken up by the hide. The weight of an ordinary hide is from 60 to 65 lbs., and the quantity of chemically pure salt to be used for a hide of this weight is from 10 to 12 lbs. The hide is spread out on the floor, with the hair side down, and the quantity of pure salt mentioned above is sprinkled evenly over the flesh side of the hide. The salt is dissolved in the natural moisture of the hide and being perfectly pure, no impurities or water, either mechanically or chemically combined, are introduced into the hide. The result of this treatment is that bacteriological decomposition is immediately stopped or suspended for an indefinite period, thereby keeping the hide in a perfectly fresh condition without decomposition or appreciable loss of hide substance. It can therefore be kept indefinitely. When it is to be tanned it is thoroughly washed with pure water, but it is not necessary that this washing should remove all the salt, as is the case where impure salt is used, since even if a small quantity of the chemically pure salt is left in the hide substance, it does not enter into any objectionable chemical reaction or exerts any prejudicial effect upon the subsequent tanning process. After undergoing this process of treatment the hide is left in a very active form and rendered more capable of reacting with the tanning material.

The process may be summed up by saying that in so far as the salt stains are concerned, the hides are treated aseptically as compared to the processes using mustard oil or zinc chloride which are antiseptic, or the process using commercial common salt, which is septic, since in this latter case considerable quantities of water are introduced into the hide, setting up bacteriological decomposition. Moreover, owing to the absence of hygroscopic impurities, especially magnesium chloride, it is possible to avoid the addition of water, since sodium chloride itself contains no water of crystallization. By the exclusion of mineral impurities and water, it is possible to save from 2 to 4 per cent. of hide substance. This method of salting hides and also the process by which common salt is

rendered chemically pure, are patented by Charles C. Moore and William Trantom, of Lymm, England.

Methods of Coloring Leather with Permanganate of Potash.

By the use of permanganate of potash in coloring leather, it is claimed that the cost is less than when the ordinary methods are employed, less logwood being required than is ordinarily used, and the shades of black are deep, rich and permanent; the grain of the leather appears smoothed down; all roughness, stringiness and beardiness are lessened, and the leather has a fine, smooth, silky feel and, when glazed, a brilliant color and a high clear finish. The process is applicable to hides and skins of all descriptions. The method of using it upon chrome-tanned skins will be described first. Other leathers may be colored in the same manner with such changes in the quantities of materials employed and in the manipulations as their different sizes and characters require.

In a suitable drum are placed, say, 450 lbs. of skins as they come from the shaving machines, together with 30 gallons of warm water, and the drum is then closed. Now dissolve 2½ lbs. of permanganate of potash in 45 gallons of warm water, and after adding to the solution 2½ lbs. of muriatic acid, 21° Bé., pour it into the drum through the gudgeon. Run the drum ten minutes, then stop it and allow the liquor to run off. Close the drum and allow it to rotate, and add as before, through the gudgeon, 2 gallons of iron liquor which has been mixed with 45 gallons of warm water. After the drum has run ten minutes, stop it and allow the spent liquor to run off. Next dissolve in 45 gallons of warm water 3 lbs. of extract of logwood and 3 lbs. of sal soda, and after the drum has been closed and started again, add the logwood and soda liquor by pouring it through the gudgeon. After ten minutes, stop the drum, open it and remove the skins. The coloring process is now complete and the skins should be washed thoroughly, preferably in a twister or polygonal drum, with warm water for twenty minutes, then fat-liquored and finished.

The iron liquor referred to may be prepared by dissolving scrap iron in dilute commercial acetic acid, and the solution when ready for use should show 10° Bé. But any suitable ferrous salt may be used. The temperature of the warm water referred to should be about 110° F. in summer and from 120° to 125° F. in winter.

Muriatic acid should never be added to a hot concentrated solution of permanganate of potash, as this results in the evolution of chlorine and the formation of manganous chloride, which is not the salt of manganese desired. The muriatic acid is added to the permanganate solution when all the required quantity of water is present. As an acidulated solution of permanganate of potash strikes very quickly on leather, there must be sufficient water present in the drum to secure even distribution over it. Skins that have not been washed clean from the hypo bath should have the requisite amount of acid added to the first 30 gallons referred to. The permanganate dissolved in water is added after an interval of about five minutes.

To determine whether a sufficient amount of permanganate has been used, throw a skin over a horse exposed to the sunlight and observe after fifteen or twenty minutes whether or not the brown color is uniform and even. If light streaks or spots develop, it is evidence that the sulphurous acid in the leather has not been entirely neutralized. Such leather should have more permanganate, but it must always be borne in mind that permanganate of potash is a powerful oxidizing agent and can be safely employed only in very dilute solutions.

On bark-tanned and extract-tanned leather weaker solutions of permanganate than those above prescribed for chrome leather should be used. When chrome-tanned skins are treated with an acidulated solution of permanganate of potash, all of the latter quickly combines with the leather, imparting to it a brown color. It is to some extent reduced by the leather itself, and it thoroughly destroys any sulphurous acid present that has been carried over from the hypo bath. Following this with a ferrous salt, all the remaining permanganate com-

pound is reduced to an insoluble modification, and the ferrous salt is oxidized to a ferric state and is at once absorbed by the stock. The final treatment with logwood and soda forms a perfectly permanent jet-black that will last as long as the leather itself. The function of the soda is not merely to assist in the formation of the color lake by neutralizing the acid liberated from the iron liquor, but it is necessary to have sufficient alkali present to neutralize all of the acid in the stock which has been taken up from the previous steps of the process. The leather should be neutral, or only very slightly, but never very, alkaline. After this treatment it can be washed perfectly clean, it being placed in a drum and not removed until all the coloring operations are completed, saving thus much handling and labor.

Only very small quantities of the chemicals used are required for a large number of skins, which makes the process not only a very economical one, effecting considerable saving over present methods, but also secures the softest possible process of applying coloring materials, as the grain is never in the least roughened or contracted; and no bloom or spew ever shows upon leather colored by this method. The fine smooth, silky feel which permanganate of potash imparts to leather is retained and emphasized by the subsequent treatment. The finish is very bright, clear and permanent. In working this process, the inventor found that the best results were obtained by using the quantities of materials and the manipulations specified, but he does not confine himself either to these proportions or to these methods of manipulations, as considerable modifications can be made without departing from the essential features of the process. The use of permanganate of potash in coloring leather is patented by William M. Norris, of Princeton, N. J.

Other methods of coloring are as follows: 1st. To 650 gallons of water in a reel, add 5 lbs. of the permanganate, previously dissolved in hot water. The temperature of the bath should be about 110° F. The skins, washed and shaved, are placed into the prepared bath. After remaining in the same,

with the paddles revolving, for thirty minutes, the leather is removed, horsed up for one-half hour, and the usual operations of staining, fat-liquoring and coloring may now be proceeded with in the ordinary manner. This treatment kills all traces of sulphurous acid in the skins, and therefore it is not necessary to use soda, borax or other alkali in the water in which they are washed, as is generally the practice. Or the permanganate may be applied in this manner:

2d. After tanning, wash the skins, stain and fat-liquor them. They are then smoothed out with a slicker, and, after being folded, grain side out, each skin is dipped into a bath consisting of a solution of permanganate of potash, which is prepared in the following manner: 5 lbs. of permanganate are dissolved in 30 gallons of water to form a stock solution. Of this stock solution 1 gallon is mixed with 12 gallons of water, which forms a bath for treating 100 lbs. of skins. In preparing the bath in the first instance, the percentage of permanganate solution may be increased to about 2 gallons; but after treating the first batch of skins an addition of 1 gallon of the solution for each subsequent batch of 100 lbs. of skins will be sufficient to maintain the bath at the proper strength. After allowing the stock to be drained well, the final coloring may be proceeded with in the ordinary manner, except that one-half the usual quantity of logwood liquor will be sufficient. If the permanganate does not appear to strike evenly, and the leather shows any indication of spots, streaks or teeth, a little salts of tartar should be added to the bath; or the stock solution may be prepared by dissolving 5 lbs. of permanganate and 2½ lbs. of salts of tartar in 30 gallons of water. The workmen who dip the skins into the liquor should wear rubber gloves.

The methods employed in coloring the skins after they have been treated with permanganate of potash vary, depending upon the shade or color that is desired. For tan shades, the preliminary treatment may be with a solution of tanning material, such as sumac or gambier, and after this has been applied the permanganate of potash is put on, and this is

followed by an application of aniline dye of the shade desired. By treating skins in this manner it is claimed that more permanent and uniform results are obtained. The process is applicable to leather tanned by the use of alum, bark, extracts, etc., as well as to chrome-tanned skins. It has been used in practice, however, mostly upon goatskins intended to be finished into glazed kid.

Tanning with Lignite Distillate in Combination with Tannic Acid.

This method of tanning with lignite distillate and tanning extract is carried out as follows: The hides to be tanned are first pickled in the usual way and are then immersed until properly tanned in a liquor obtained by the destructive distillation of a lignite coal of the cretaceous age which occurs in several counties in Arkansas, including the county of Ouachita described on page 28 of "The Minerals and Rocks of Arkansas," published by F. L. Harvey, B. S. in 1886. This particular lignite will be referred to as Ouachita lignite.

The tanning liquor is obtained by the destructive distillation of the lignite for a period of from seven to ten hours at temperatures of from 300° to 450° F., the distillation being performed in any usual form of retort. The distillate consists principally of two distinct products, a watery liquor and an oil, which separate by gravity, the watery liquor being the heavier and soon settling, when the full liquor is allowed to stand, so that it can be readily drawn off from the oil. The watery distillate carries in solution certain of the heavier phenols, and this alone may be used, or the full liquor containing the oil may be used, the oily distillate operating to impart a dark color and a distinctive odor to the leather.

It has been found that in practicing this process, the leather produced is too porous for ordinary uses, making it necessary that it be subjected to special treatment to impart the desired density and firmness. On the other hand, it is well known that hides tanned by tanning extracts, alum, chrome, and the like, are hard and brittle and break easily if bent, making it

necessary to treat them with grease to render them soft and pliable.

By using as a tanning agent a mixture of the aforesaid liquor distilled from Ouachita lignite and one of the well-known tanning agents, as hemlock extract or its equivalent, and for some skins, particularly sheepskins, a mixture of Ouachita and a mineral tanning agent as alum, chromium or its equivalent, a leather will be produced, it is claimed, having the density and firmness of leather tanned with usual vegetable or mineral tannages now in common use and the softness and pliability of leather tanned with the Ouachita, and that the tanning process requires only from one-quarter to one-third of the time required for tanning similar hides by present processes. For example, it requires from three to four months to tan sole leather and harness leather by present methods, whereas by this newer process, leather of the same character, and believed to be of superior quality, can be produced in from four to five weeks.

The hides are first pickled in the usual way and are then immersed in a bath consisting of a mixture of liquor produced by the destructive distillation of Ouachita lignite and a usual tanning agent, preferably one which contains tannic acid, as extract of hemlock, oak, or quebracho. For most purposes it is advisable to mix said tannages in the proportions of about 11 lbs. of extract to 40 gallons of the distilled liquor. Best results are also said to be obtained by adding the extract gradually, increasing the proportion and effect of the extract as the process progresses. Thus, at the beginning of the process 1 lb. of the extract is added to the 40 gallons of Ouachita; at the beginning of the second week, 3 lbs. of the extract are added; at the beginning of the third week, 3 lbs.; and at the beginning of the fourth week, 4 lbs. It is not necessary, however, to limit the proportions to those specified, as excellent results may be obtained by varying within a considerable range.—Patented by James C. Cleary, of Chicago, Illinois.

Another Process of Tanning with a Lignite Distillate.—A

process of tanning hides with liquor distilled from Ouachita county lignite is patented by George S. Kimball, of Camden, Arkansas, assignor to Michael W. Borders, of Chicago. The hides are first pickled in the usual way and are then immersed in a bath consisting of liquor such as is produced by the destructive distillation of this particular kind of lignite of the cretaceous period, until properly tanned. The duration of the immersion will vary with different hides, but experienced operators can readily ascertain by examination when the process is completed. In the case of sheepskins, it has been found in practice that they can be tanned in twelve days. When the tanning process is completed, the skins are removed from the liquor and subjected to any desired finishing process.

The lignite from which the tanning liquor used is produced has no name which will serve to differentiate it from other lignites. So far as appears, therefore, the only manner of identifying said lignites is to define the locality in which they occur, which include several counties in the state of Arkansas, including the county of Ouachita. The particular lignite from which the tanning liquor used in this process is produced is therefore referred to as Ouachita lignite. The liquor is obtained by the destructive distillation of the lignite for a period of from seven to ten hours at temperatures of from 300° to 450° F., and may be obtained in any usual form of retort. The distillate consists principally of two distinct products to wit: a watery liquor and an oil, which separate by gravity. The watery distillate is characterized by the fact that it carries in solution certain of the higher phenols, and it is believed that the tanning properties of the liquor are due to the oxidation products of these phenols.

In the practice of the application of this process, the liquor is used full strength as produced, without dilution or change of any kind. Also, while it is preferred to use the watery distillate alone, its tanning action is not appreciably affected by the presence of the oil, and, if desired, the full liquor may be used, in presence of the oily distillate, which is almost

black in color, operating to impart a dark color and a highly phenolic odor to the leather; due to the presence of the insoluble phenols. A liquor which, as regards its tanning properties and characteristics, is the substantial equivalent of the orginal watery distillate may be produced from the oily distillate by treating the same with a weak alkaline solution, such as saturated lime-water solution, a 5 per cent. solution of carbonate of soda, or a 2 per cent. solution of caustic soda, in the following manner: A quantity of the alkaline solution equal to from ½ to ⅔ of the quantity of the oily distillate to be treated is added to the oily distillate and the mixture is stirred for one hour. The alkaline solution operates to dissolve the phenols remaining in the oil and, being heavier than oil, soon settles when allowed to stand and may be drawn off—all substantially as in the case of the original watery distillate. Said solution, after being drawn off, is neutralized by the addition of acid, when it is ready for use in connection with this process of tanning, said liquor being used in the same manner as the original watery distillate. The tanning action of the liquor produced by treating the oil distillate with an alkaline solution is due to the presence, in solution, of certain higher phenols.

Waterproof Filling for Sole Leather.

The following described method of waterproofing and otherwise improving chrome-tanned and bark-tanned sole leather is patented by William R. Smith and assigned to the Buffalo Leather Co., of Buffalo, N. Y.

A bituminous composition is introduced into the leather by bringing the latter into contact therewith at a temperature high enough to render the composition thin and fluid and not high enough to injure the leather. The maximum temperature varies with the kind of tannage, the vegetable-tanned leather resisting a temperature of 150° F., and chrome-tanned up to about 200° F. To insure proper impregnation, the leather should be free from oils, glucose, etc. It is best to treat the leather in a rotary tumbling drum, the fluid mixture

and the heated soles being put into the drum, which is steam-jacketed and heated, so that the temperature of the air within it is somewhat above the melting point of the said mixture, the drum being preferably provided with radial inwardly projecting shelves adapted to raise and release the composition and the pieces of leather as the drum rotates. The operation is continued until the composition has thoroughly permeated the leather. The leather employed is preferably of a porous character such as chrome sole leather. Whole sides may be treated, but the inventor prefers for economy of the mixture to tumble the leather with the composition after it has been cut into forms or soles of the final size. The process is ordinarily completed within one-half hour.

The bituminous composition used contains as essential components a solid bitumen possessing at normal or somewhat higher temperatures a considerable degree of elasticity, combined with bitumen which, in its fused condition, possesses marked penetrative powers. The variety of elastic bitumen preferred is elaterite or "mineral rubber," and the variety of penetrative bitumen is ozocerite. While the mineral elaterite is greatly to be desired in such a composition, its use has been prevented by its infusible and insoluble character, and its viscosity when brought into a state of fusion by admixture with other bitumens. This difficulty is overcome by altering the character of the elaterite so as to render it easily soluble in melted ozocerite or equivalent paraffin. When elaterite is gradually added to a melted bitumen, such as gilsonite, which is capable of withstanding a high degree of heat without decomposition, it is softened and gradually dissolved, and thus an infinitely large quantity of it can be melted in the presence of a small quantity of gilsonite. The elaterite fusible at high temperature without decomposition and soluble in hot paraffins and forming therewith a thin, penetrating liquid, is herein termed "modified elaterite."

An example of modified elaterite is the so-called "kapak," a bitumen well-known in the trade and produced from elaterite. The elaterite found in Utah has all the desired qualities

for this process. It is non-friable, tenacious, only moderately brittle at low temperatures, elastic at normal temperatures, resilient, and resistent to chemical alteration. When slightly warmed it becomes more flexible and more elastic so that if drawn out or bent, (like rubber), it tends to return to its former shape upon the release of the disturbing force. When raised to a high temperature it undergoes destructive distillation and carbonization without melting. It may, by fusion with a solid paraffin body, be brought partly into solution, but it is preferable to render it substantially soluble in melted solid paraffin by previous modification. Ozocerite, having a higher melting point than ordinary solid paraffine, is found to be a superior ingredient in this special composition. The proportion of paraffine to modified elaterite naturally varies somewhat according to the specific qualities given the latter, 3 parts of ozocerite to 1 of modified elaterite being generally suitable.

The flexibility and resiliency of elaterite are found to be measurably retained by the composition, and in addition it possesses a surface frictional resistance such as is possessed by beeswax. The value of this latter quality is clearly observed when chrome-tanned sole leather is worked through this process. Notwithstanding the durable character of chrome leather, its use for the soles of shoes has been greatly limited by the slipperiness of the leather in wet weather. When chrome leather is impregnated with the composition of this process, this undesirable quality is effectually overcome. The wearing qualities of heavy leather of all kinds for use for soles and heels is greatly increased by this treatment. When finished leather filled with ordinary paraffin wax is placed in hot sunshine or near a stove, there is a strong tendency for the wax to melt and exude, thus defacing the shoe or other article. On account of the viscosity and high melting point of the composition used in this process, the leather is not injured by any similar elevation of temperature.

A Process of Preparing a Tanning Agent From the Waste Products of Wood-Pulp Manufacture.

The following description relates to a new process of treating sulfite pulp-digester liquor to produce a tanning material. The sulfite liquor is the waste product of sulfite paper-pulp works. It is at present usually run into rivers and thus becomes a public nuisance and is injurious to fish and cattle. The greatest drawback to utilization of the waste liquor is the comparatively large amount of sulphur contained therein in organic combinations. The sulphur-containing products always show disadvantage in application, especially when used in the tanning industry. The products also contain an undesirable quantity of vegetable gum and other carbohydrates, which cannot be profitably separated from the other constituents, and are detrimental when the liquor is used for tanning purposes. By the application of this patented process the removal of the sulphur from the digester liquor may be easily effected, and at the same time the vegetable gums and carbohyrates may be separated from the tanning material. The process has the further advantage of producing a tanning agent in solid form.

The raw liquid from the works contains some free sulphurous acid which is removed by adding lime or its equivalent in the usual way in form of sulfite of calcium. The liquid thereby becomes neutral against litmus, and for convenience sake may be somewhat concentrated. The resulting liquor is analyzed, and especially the percentage of sulphur is determined according to the methods employed in organic analyses. For every 32 parts by weight of combined sulphur present there are added 65 parts by weight of potassium cyanid, or an equivalent amount of other cyanid, preferably in the form of a strong aqueous solution. The mixture is transferred into an autoclave and heated from four to five hours, to a temperature of 150° C., (302° F.) whereby a pressure of about five atmospheres results.

After cooling, the reaction mass is transferred into a vessel, then diluted with water and allowed to rest for about twenty-

four hours. At the end of this time, the sediments have settled to the bottom and the clear, supernatant liquid above is drawn off into a separate vessel and the solid sediment or precipitate washed by decantation. If preferred, a filter press may be used. The precipitate represents, neutral sulfite of calcium and may be used again in the manufacture of paper pulp.

The resulting liquor which is now free from sulfite of calcium is acidulated by a mineral acid, for instance hydrochloric or sulfuric acid, whereby a copious, brownish precipitate of an organic cyanogen compound is obtained that may be separated from the liquid by filtration. It is washed a little with water and dried at ordinary temperature. High temperatures have to be avoided because the precipitate would become insoluble in water. The brownish precipitate is comparatively insoluble in the mother liquid which contains gums and carbohydrates or saccharine matter, inorganic salts and traces of the new product. The new product, the brownish precipitate, if dissolved in water, forms a useful tanning substance. It precipitates gelatin, glue, pancreatin, etc., and is absolutely absorbed by skin.

In place of a cyanid, sulfo-cyanids may be used with equal effect except to note that no sulfite of calcium will precipitate. When the resulting liquid is precipitated by a mineral acid a similar product is obtained which also precipitates glue, gelatin, pancreatin, etc., and is also absorbed by animal skin.

This product has the odor of mustard oil and evidently is not so desirable as a tanning substance as the product first described, because it contains sulfur.

The very best tanning product is obtained by using a freshly prepared aqueous solution of calcium cyanamid, $Ca(CN)_2$ in place of the above mentioned cyanids. The calcium cyanamid is used, in freshly prepared aqueous solution, as above described.

The novel air-dry product represents a brownish powder which is soluble in lukewarm water and remains in solution on cooling. The products obtained by all three methods contain nitrogen and may be hydrolized by boiling them, for

instance with dilute hydrochloric acid. The products obtained by hydrolysis are semi-crystalline, insoluble in the usual solvents, for instance in alcohol, ether, acetone, amyl alcohol, benzin, etc., and very slightly soluble in water. They are free from nitrogen and when obtained as described probably represent lactons or anhydrids. These hydrolized substances, however, are at present practically useless, especially for tanning purposes, because they are insoluble in water. It is important, however, in substituting the sulfur-bearing or sulfo group by another radical, to prevent a return reaction. In the case of the cyanids and cyanamids, the formation of the insoluble calcium sulfite, $CaSO_3$, is sufficient to prevent this.

In the case of a cyanid, the addition of calcium chlorid and ammonium chlorid besides the cyanids was found to increase the quantity of the product. Further addition of alkaline hydrates is needed as soon as it is shown that the mixture of the reagent generates hydrocyanic acid already at ordinary temperature. In the case of calcium cyanamids an excess of the reagent is less detrimental because it will be decomposed by heat anyhow and calcium carbonate and ammonium carbonate will be formed. In the case of hydroxyl groups being present an addition of oxidizing substances like potassium chlorate is needed. The products thus obtained may be used for producing various organic substances, colors, medicines, and the like.

The tanning solutions prepared from the novel products can not be analyzed as to their tanning value by the conventional oxidation methods with permanganate of potassium, indigocarmine, and hide powder; their tanning value is determined by determining the total solids and the ashes before and after treating them with hide powder. The difference represents the absorption of the substance by the hide powder. Otto Grothe, of Jersey City, New Jersey, has taken out a patent on the above-described process.

INDEX

ACETIC acid bath, for use after dyeing, 416
for softening water, 408
Acid and basic blacks for dyeing calfskins, 149, 150
dyestuffs, dyeing vegetable-tanned sheepskins with, 54, 55
salt, pickling sheepskins with, 6, 7
blacks, dyeing calfskins black with, 111, 112
burns, treatment of, 452
colors and bisulphate of soda, dyeing with, 23
application of, 409, 410
direct dyeing of side leather with, 275, 276
dissolving of, 409
dyeing furs with, 170–172
goatskins with, 201–203
dyes, sumac mordant for, 204
dyestuffs, coloring calfskins with, 119, 120
chrome-tanned sheepskins with, 18, 19
for light shades, 22, 23
shades most in demand, 27
fat-liquor for white side leather, 307, 308
pickled grains, chrome tannages for, 268–270
quantity of, for softening water, 408
Acids, use of, in deliming and pickling, 419–427
Alfalfa extract, tanning with, 554, 555
Algin, 472
Alizarine brown on calfskins, 124
side leather, 278, 279
Alum and chrome tanning process for goatskins, 190–192
gambier, tanning of hair skins with, 168
salt, tanning hides for coats, robes, etc., with, 177, 178
leather, black shades on, 493
blacking the flesh sides of, 493, 494
re-tanning of, with chrome, 490, 491
Alum salt and hemlock extract, tanning with, 91, 92
sumac and oak bark, tanning sheepskins with, 52
tannage for goatskins, 217, 218
pickled sheepskins, 36–40
-tanned furs and hairskins, oiling of, 164
lace leather, 354–356
sheepskin leather, coloring of, 40–43
tawing, process of, 540, 541
with Turkey red oils, 539
Alumina-pickled grains, tanning process for, 270
Ammonium butyrate, deliming and bating with, 422–424
deliming and drenching with, 106, 107
for deliming goatskins, 185
Amyl alcohol, 474
Aniline dyestuffs, coloring vegetable-tanned sheepskins with, 55–57
Arsenic limes, 259
Automobiles, leather for, 519–523
Azure blue on sheepskins, 42

BACTERIAL bate, bating with, 264, 265
Bag leather, bleaching of, 226–228
finishing of, 349, 350
leathers, chrome, 292
manufacture of, 344–350
Banana liquid, 473, 474
Bark-tanned leather, general mode of dyeing, 402
Basic and acid blacks for dyeing calfskins, 149, 150
colors, dissolving of, 408
dyeing goatskins with, 203, 204
dyes, sumac mordant for, 204
dyestuffs, coloring calfskins with, 120
chrome-tanned sheepskins with, 19, 20
fat-liquor for side leather colored with, 282
for shades in most demand, 27
tannin mordant for, 276

Basicity of tanning liquor, 508
Bating and deliming, some patented processes for, 552–559
with ammonium butyrate, 422–424
drenching kangaroo skins, 239–241
calfskins, 104–106
glove leather, 489
goatskins, 183, 184
hides for plump leather, 325
methods of, 262–265
pigskins, 437
scudding and drenching split sealskins, 431
sealskins, 428, 429
sides for bag and case leathers, 345
harness leather, 298
with bacterial bate, 264, 265
bichromate of potash, 553, 554
bran, 559
dermiforma, 557, 558
dog dung, 555, 556
glucose, sulphur and yeast, 554, 555
mild fermented bate, 262–264
molasses, 556, 557
sal ammoniac and pickling with formic acid, 421, 422
sulphonated oil and sal ammoniac, 552, 553
sulphuric acid, Glauber's salt and borax, 554
Beamhouse work, notes on, 258–260
Beige on calfskins, 122
goatskins, 205, 206
Belt leather, chrome-tanned, 292, 301–303
cement for joining the laps of, 474
Belting leather, drum tanning for, 369, 370
use of patented depilatories upon hides for, 499, 500
Bichromate of potash, bating with, 553, 554
Biscuit on goatskins, 205, 206
Bismark brown on sheepskin leather, 25
Bisulphite of soda, bleaching leather with, 224
Black chrome oil grain leather, 288, 289
dye, preparation of, 43
embossed sheepskins, finish for, 64, 65
finish on Indi-tanned skins, 72
flesh and grain on vegetable-tanned upper leather, formulas for, 329, 330
Black glazed finish on chrome goat leather, 215,216
sheepskins, 31–33
grain and blue or black flesh on kangaroo leather, 250
leather, finishing vegetable-tanned grains into, 335
on alum leather, 493
Chinese goatkins, 169, 170
chrome kangaroo, 244, 245
leather, 450
side leather, 279, 280
-tanned calfskins, 111, 112
goatskins, 211–213
colored leather, 411, 412
furs, 172
with furrol colors, 173–175
India-tanned skins, 69, 70
vegetable-tanned calfskins, 146–150
skins, 414, 415
velvet and suede leathers, 154, 155
wax calf leather, 128
woolskins, 93, 94, 95
ooze leather, 157, 158
seal rabbit, dyeing of, 176
stain on vegetable-tanned leather, 404
with logwood on chrome-tanned skins, 414
Blacking calfskins with logwood and salt of titanium, 146, 147
defective spots on chrome goat leather, 215
flesh side of alum leather, 493, 494
for vegetable-tanned leather, 448, 449
harness leather, 300, 301, 448
sealskins, 430
sheepskins, 12–14
varnish, bright, for shoe leather, 447, 448
vegetable-tanned sheepskins, 53, 54
with direct dyeing chrome black, 13, 14
hematin and direct chrome black, 12, 13
logwood and titanium potassium oxalate, 13
Blacks, acid and basic, for dyeing calfskins, 149, 150
Bleaching and finishing russet leather, 232, 233
chamois leather, 83–85
leather, 221–237
for the production of a regular and light color, 505, 506
sides for bag and case leathers, 347, 348

Bleaching skins with the hair on, 169
woolskins, 89
Blood, 466, 467
albumen, 467
preparation of, for leather finishes, 451
Blue flesh and black grain on vegetable-tanned upper leather, 330
dark, on calfskins, 149
on furs, 172
with nigrosine, 450
Boarded finish for chrome side leather, 285
Bohm, Charles, patent of, 533
Boracic acid, drenching with, 422, 423
Borax and lactic acid, bleaching leather with, 225
neutralizing tanned goatskin leather with, 193, 194
sumac and sulphuric acid, bleaching leather with, 221, 222
Botton lac, 473
Box calf, final dressing for, 452
Brains for tanning buckskins, preparation of, 485, 486
Bran and lactic acid, bating calfskins with, 104, 105
bating with, 559
deliming with, 4, 5
drench for calfskins, 106
formulas for, 4, 5
Brandt, Carl, patent of, 535, 536
Bright blacking varnish for shoe leather, 447, 448
boarded grain leather, finish for, 335, 336
finish, smooth or boarded, for calfskins, 118
Bronze dyeings on sheepskins, 61–63
Brown dye, preparation of, 43
on calfskins, 124
chamois leather, 495, 496
furs, 172
shades on goatskins, 204, 205
vegetable tanned sheepskins, 58, 59
Brush killing with caustic soda lye, 174
Buckskin, chrome tanned, 443, 444
colored chrome, 445
white, 441–443
chrome, 444, 445
Buckskins, Indian method of tanning, 485–487
tanning of, 441–445
Buenos Ayres, degreasing sheepskins in, 35, 36
Butyric acid, deliming with, 422
sheepskins with, 5
in chrome-tanning, 458, 459
use of, in pickling skins, 107

CALF leather, chrome, process of manufacturing, 511–513
chrome-tanned wax, 126-129
damping and staking of, 115
ooze, notes on, 157–159
Calfskin glove and mitten leathers, 129–131
leather, manufacture of, 99–159
neutralizing of, 110
oiling of, 115
vegetable-tanned, manufacture of, 138–152
white, 132–134
Calfskins, bating of, 104–106
bright finish, smooth or boarded for, 118
chrome-tanned, black on, 111, 112
coloring of, 118–126
ooze, 134–138
clearing the grain of, and setting the color with tartar emetic, 122
colored chrome, seasoning for, 118
deliming of, 427
fancy leather, 513–516
fat-liquoring of, 112–115
glazed finish for, 116
gun-metal finish for, 117, 118
light shades of color on, 122
mordants for, 120, 121
popular shades of color on, 123–126
processes of chrome-tanning, 108–110
quebracho-tanned, coloring of, 155–159
retanning of, for wax calf leather, 127
seasoning for dull finish, 116
glazed finish, 116, 117
smooth dull finish for, 117
soaking of, 99, 100
vegetable-tanned, fat-liquoring of, 143–146
Camel brown on sheepskins, 41
Cape grain skins, tan on, 492
Carragee, 471
Carriages, leather for, 519–523
Case leather, finishing of, 349, 350
leathers, manufacture of, 344–350
Casein, 463, 469 471
Castor leather from sheepskin splits, 79, 80
oil and potash soap and fat liquor, 394, 395
fat liquor, 395
soap, how to make, 394
sulphonated, preparation of, 392, 393
sulphonating of, 387, 388
Cattle hides, tanning of, for robes, coats, etc., 176–179

Caustic soda, addition of, to lime liquor, 259, 260
Cement for joining the laps of chrome-tanned belt leather, 474
Chair splits, finishing splits into, 365–367
Chamois leather, 80–85
dyeing of, 494, 495
Chamoising, 539, 540
Champagne color on calfskins, 122
goatskins, 205, 206
sheepskins, 25
Chestnut brown on sheepskins, 41, 42
extract, function of, 316, 317
successful use of, 315, 316
tanning sheepskins with, 53
sides with, 315–319
China goatskins, dyeing black on, 169, 170
Chlorinating furs, 171
Chocolate brown, on calfskins, 123, 124
sheepskin leather, 25
side leather, 278
shade on goat-skins, 210
Chondrin, 468
Chromate colors, dyeing furs with, 172, 173
Chrome alum, dissolving of, 375, 376
tanning liquor, 371
bag and belt leathers, 292
black, direct dyeing with, 13, 14
calf leather, process of manufacturing, 511–513
calfskins, colored, seasoning for, 118
goat leather, clearing the grain of, of grease, 214, 215
finishing of, 213–216
grain leather, heavy, 286–288
hydrate, 507
kangaroo, dyeing black of, 244, 245
lace leather, 351–354
leather, black on, 450
bleaching of, 221
coloring, 412
after fat-liquoring and drying, 410, 411
drying of, before coloring and finishing it, 373, 374
fat liquors for, 200, 201
from India-tanned kips, 303–305
how to retan, 272, 373
increasing the suppleness of, 374, 375
neutralizing of, 372
oiling of, 397–399
Russia, notes on, 157–159
Chrome liquor, retanning India-tanned skins with, 73
liquors, cost of, containing 100 lbs. of chromium oxide, 507, 508
Chrome oil grain leather, black, 288, 289
process for glove leather, 490
residues, recovery of, 377, 378
retanning, 97
alum leather with, 490, 491
sheepskins, dyeing and fat-liquoring of, after drying out from the chrome tannage, 29, 30
flesh-finished, 27, 28
neutralizing of, 12
washing of, 12
side glove and mitten leather, 290–292
side leather, black on, 279, 280
dyeing of, 275–280
fat liquors for, 280–283
finishing of, 283–290
sole leather, water-proofing of, 296, 297
sores, ointment for, 452
tannages for acid-pickled grains, 268–270
one-bath, 506–511
tanned belt and strap leathers, 301–303
leather, cement for joining the laps of, 474
buckskin, 443, 444
calfskins, black on, 111, 112
coloring of, 118–126
furs and woolskins, 166, 167
goatskins, black on, 211–213
dyeing of, 201–213
two-bath processes for, 186–188
harness leather, 297–301
leather, process of fat-liquoring, 197, 198
titanium mordants for, 412–415
leathers, difference between one-bath and two-bath, 196, 197
ooze calfskins, 134–138
patent leather, 309–311
sheepskins, coloring and fat-liquoring of, after drying out, 28, 29
fat liquors for, 14–17
finishing of, 31–45
methods of coloring, 17, 31
white, 30, 31
side leather for sporting shoes, 158, 159
skins, black with logwood on, 414
sole leather, 293–296
splits, 358–360
wax calf leather, 126–129
tanning, butyric acid in, 458, 459

Chrome tanning calfskins, 108–110
liquors, properties of, 509–511
new process of, 376, 377
new two-bath process of, for sheepskins, 192, 193
notes and suggestions on, 371–378
sheepskins, 7–12, 194–196
side leather, 268–271
with glucose, glycerine, steam and saccharine substances, 272–275
upper leather, fat liquor for, 281
velvet leather, 308
Chromium oxide, cost of liquors containing 100 lbs. of, 507, 508
Claret on furs, 172
Cleaning furs, 165
white fur rugs, 168
Clearing bath for sheepskins, 55
grain and setting the color with tartar emetic, 122
skins, 404–406
skivers, 404–406
Cleary, James C., patent of, 568, 569
Coats, tanning of hides for, 176–179
Cod oil and neatsfoot oil, sulphonating of, 386, 387
Coffee brown on sheepskins, 42
Collar leather, bleaching of, 226–228
Collodion, 473, 474
Color, light shades of, on calfskins, 122
popular shades of, on calfskins, 123–126
Colored chrome buckskin, 445
goat leather, seasoning for, 216
leather, preventing fading of, 416, 417
to dye black, 411, 412
sheepskins, seasonings for, 33, 34, 63, 64
side leather, finish for, 286
skins, re-dyeing of, black, 14
Coloring alum-tanned sheepskin leather, 40–43
and finishing India-tanned skins, 65–75
chamois leather, 81–83
chrome calfskins, 118–126
goatskins with natural dyestuffs, 209, 210
leather, 412
after fat-liquoring and drying, 410, 411
patent leather, 310
sheepskins, 17–31
leather, lactic acid in, 415, 416
with permanganate of potash, methods of, 564–568
Coloring quebracho-tanned calfskins, 155–159
grains, 338–340
sheepskin leather after fat-liquoring, 26, 27
sides for bag and case leathers, 347, 348
skins, 404–406
skivers, 404–406
vegetable-tanned side leather, 337–340
velvet and suede leathers, 153
with natural dyestuffs, 41–43
phosphine dyestuffs, 24
woolskins, 92–95
Color solution, preparation of, 403, 404
Colors, good, on calfskins, 152
titanium mordant of, 151, 152
Coltskins, deliming of, 424
Combination tannage for calfskins, 142, 143
sheepskins, 50–52
sides, 320, 321, 322
-tanned leather, fat liquor for, 333, 334
Combined dyeing process, 21, 22
vegetable and mineral tannage, 536, 537
Conservation of skin substance, 381, 382
Corichrome salts, 493
Cowhide leathers, neutralizing and washing of, 271
Cowhides, deliming of, 424
manufacture of leathers from, 252–370
Cow seal, 427
Crushed levant grain on India-tanned skins, 74
Currying, modern, features of the superiority of, 501, 502

DAMPING and staking calfskin leather, 115
Dark tan on sheepskin leather, 24
Defibrinated blood, 451, 466, 467
Degreasing dogskins, 164, 165
pigskins, 436
sheepskins, 34–36
skins, method of, 545, 546
woolskins, 89, 90
Deliming and bating, some patented processes for, 552–559
with ammonium butyrate, 422–424
drenching, ammonium butyrate for, 106, 107

Deliming goatskins with ammonium butyrate, 185
heavy upper leather and patent leather, 424–427
horsehides, coltskins, cowhides, etc., 424
sides for sole leather, 295
test, 107, 424, 516–518
use of acids in, 419–427
with bran, 4, 5
butyric acid, 422
Depickling sheepskins, 40
Depilatories, formulas for, 2, 3
patented, methods of using, 496–500
Depilatory compounds for woolskins and hairskins, 379–381
paint, application of, 3
Dermiforma, bating with, 557, 558
Diamine colors, 123
dyeing with, 23
Direct leather black, dyeing calfskins with, 147
Dissolving and storing dyestuffs, 408–410
Dog dung, bating with, 555, 556
Dogskins, degreasing of, 164, 165
Dolley and Crank, patent of, 525–529
Dongola tannage for calfskins, 141, 142
kangaroo leather, 249
Drab on goatskins, 205, 206
Drench, formic acid and lactic acid, 420
Drenching glove leather, 489
goatskins, 184, 185
with boracic acid, 422, 423
bran, 4, 5
Dressing, colorless, for russet leather, 233
final, for box calf, 452
for leather goods and furniture, 417
glove leather, 487–490
liquor for glove leather, 489, 490
Dried goatskins, soaking of, 180, 181
Drum killing, and soda solution, 173
with caustic soda lye, 174
milk of lime, 173
stuffing leather, 502–504
tanning for sole and belting leathers, 369, 370
Dry hides, soaking of, 253, 254
sodium sulphide process for, 257, 258
-salted goatskins, soaking of, 181
Drying chrome leather before coloring and finishing it, 373, 374
kangeroo leather, 246
Dubbing for stuffing alum-tanned lace leather, 354, 355
Dull finish for chrome goat leather, 216
kangaroo leather, 247
Dull finish on chrome side leather, 284
seasoning for, 33
finished side leather, fat liquor for, 282
Durio, G., patent of, 542, 543
Dye bath for woolskins, 93
and fat-liquoring chrome sheepskins after drying out from the chrome tannage, 29, 30
Dyeing chamois leather, 81–83, 494, 495
Chinese goat skins, 169, 170
chrome goat leather, 213, 214
kangaroo black, 244, 245
leather black, 450
side leather, 275–280
black, 279, 280
-tanned calfskin black, 111, 112
calfskins, 118–126
goatskins black, 211–213
furs black with furrol dyes, 173–175
with acid colors, 170–172
chromate colors, 172, 173
glove leather, drum for, 491
goatskins, 201–213
leather, acetic acid bath for use after, 416
formic acid in, 415
notes and suggestions on, 408–419
toning down of bright shades, 401
light shades with acid dyestuffs, 22, 23
method of, for good colors on calfskins, 152
popular shades, formulas for, 24–26
process, combined, 21, 22
semi-chrome leather, 97, 98
sheepskins with fancy effects, 59–61
suede leather, 137, 138
vegetable-tanned calfskins black, 146–150
sheepskins, 53–75
velvet leather, 137, 138
with acid colors and bisulphate of soda, 23
Dyestuff, improvement of the affinity of, for leather, 402
phosphine, coloring with, 24
Dyestuffs, acid, coloring chrome-tanned sheepskins with, 18, 19
dyeing light shades with, 22, 23
for shades most in demand, 27
basic, coloring chrome-tanned sheepskins with 19, 20
for shades most in demand, 27
natural, coloring with, 41–43
goatskins with, 209, 210
solution of, 209
storing and dissolving of, 408–410

EGG albumen, 467
Eggyolk, 463, 464
Eitner, hints by, regarding firmness in sole leather, 477, 478
process of tanning with formaldehyde by, 43, 44, 479, 480
Elaterite, 572, 573
Embossed sheepskins, finish for, 64, 65
skivers, 77

FANCY effects, dyeing sheepskins with, 59–61
leather calfskins, 513–516
Fat-liquor, definition of, 460
for chrome side glove and mitten leather, 291
low-priced leather, 391, 392
formulas for side leathers, 333, 334
inventor of, 461
Fat-liquoring calfskins, 112–115
chrome-tanned leather, 197, 198
patent leather, 310
kangaroo leather, 245, 246
notes on, 390–394
process of, 395–397
semi-chrome leather, 98
side leathers, 331–337
vegetable-tanned calfskins, 143–147
sheepskins, 59
wax calf leather, 127, 128
white calfskin leather, 132–133
side leather, 307, 308
Fat liquors, constitution of, 461
for calfskins, formulas for, 112–115
chrome lace leather, 352, 353
side leather, 280–283
-tanned sheepskins, 14–17
manufacture and application of, 460–466
new, 395–397
receipts for, 198–201
Fatty acids, free, sulphonating of, 393
Fermented bate, mild, bating with, 262–264
Feval, Leon, patent of, 519–523
Fig soap, 465
Filhol, M. J., patent of, 545, 546
Finish, black glazed, on chrome goat leather, 215, 216
dull, for chrome goat leather, 216
for bright boarded grain leather, 335, 336
calfskins, 116–118
colored India-tanned skins, 72, 73
Finish for embossed sheepskins, 64, 65
wax calf leather, 129
Finishing bag and case leathers, 349, 350
calfskins into ooze leather, 135, 136
chamois leather, 81
chrome goat leather, 213–216
lace leather, 353–354
-tanned patent leather, 310, 311
sheepskins, 31–45
side leather, 283–290
imperfect grains into patent tipping, 350, 351
India-tanned skins, 72–75
kangaroo leather, 247, 251
leather, materials used in, 466–474
notes and receipts for, 446–453
rough bag and case leather, 348–350
side leathers, 331–337
splits, 358–369
into Goodyears, chairs splits, etc., 365–367
suede leather, 137, 138
upper leather, process of, 532, 533
varnish for patent leather, pyroxylin, 523–525
velvet leather, 137, 138, 153, 154
white calfskin leather, 133
side leather, 308
Fish glue, 469
skins, tanning of, 534, 535
Flesh color on sheepskins, 42
-finished chrome sheepskins, 27, 28
of calfskins, coloring of, 148, 149
Fleshing oil, 398
Flexibles, splits for, 327, 328, 366
Floss, 430
Flour paste, 365
Foerderer, Robert, inventor of emulsified fat liquor, 461
Formaldehyde, Eitner's process of tanning with, 479, 480
German process of tanning with, 543–545
Miller patent on tanning with, 478
Payne and Pullman's patent of tanning with, 478, 479
preparation of skins for tanning with, 480
preservation of skins by, 475, 476
tannage for kips, 481, 482
sheepskins, 480, 481
white calfskin leather, 133, 134
tanning with, 43–45
woolskins with, 90
Formic acid and lactic acid drench, 420
salt, pickling with, 107, 108, 185

Formic acid, deliming and picking skins with, 5, 420, 421
in leather dyeing, 415
pickling with, 421, 422
soaking calfskins with, 100
softening water with, 408
Formic aldehyde, tanning and plumping leather with, 525–529
Fox, red-haired, dyeing of, 175, 176
Furniture, leather for, 519–523
Furrol dyes, dyeing furs black with, 173–175
Fur rugs, white, cleaning of, 168
Furs, alum-tanned, oiling of, 164
chlorinating of, 171
chrome-tanned, 166, 167
cleaning of, 165
dyeing black of, with furrol colors, 173–175
of, with chromate colors, 172, 173
with acid colors, 170–172
greasy, washing, 163
killing processes for, 173, 174
light shades on, 172
liming of, 165, 166
mordanting of, 174, 175
oil process for tanning, 163, 164
soaking of, 160
tanning and dyeing of, 160–179
Fustic and logwood mordant, 24
extract and diamine and anthracene colors, dyeing goatskins with, 205, 206
mordant, 20, 21, 121

GAMBIER and fustic mordant, 120, 121
salt tannage, 560, 561
sumac, retanning leather with, 326–328
sumac tannage for kangaroo leather, 248, 249
mordant, 20
for tan shades on goatskins, 204
sumac and oak extract, tanning sides with, 319, 320, 384
tannage for calfskins, 139, 141
tanning sides with, 321
woolskins with, 91
Gelatine, 467–469
Gilsonite, 572
Glazed chrome upper leather, seasoning for, 446, 447
finish for calfskins, 116, 117
on chrome side leather, 284
seasoning for, 32, 33
Glove leather, alum-tannage for, 38
bating of, 489
by the chrome process, 490
calfskin, coloring of, 130, 131
tanning of, 129, 130
chrome side, 290–292
drenching of, 489
dressing liquor for, of, 487–490
drum for dyeing, 491
gray shades on, 493
light yellow color on, 130, 131
liming of, 488, 489
side chrome, fat-liquor for, 291
finishing of, 291, 292
washing back of, before dyeing, 490, 491
yellow, 290, 291
leathers, notes on, 487–496
Gloves, dye for, 26
nappa leather for, 45–48
Glucose, glycerine, steam and saccharine substances, chrome-tanning with, 272–275
preventing souring of, 272
sulphur and yeast, bating with, 554, 555
Glue, 467–469
Glutin, 468
Goatskin leather, tanned, neutralizing and washing of, 193, 194
leathers, manufacture of, 180-220
Goatskins, alum and vegetable tannages for, 217–220
bating of, 183, 184
Chinese, dyeing black of, 169, 170
chrome-tanned, dyeing of, 201–213
fat liquor for, 200
two-bath processes for, 186–188
clearing the grain of, of grease, 205
colored, fat liquor for, 201
drenching of, 184, 185
dull-finished, fat liquor for, 199, 200
lactic acid drench for, 419, 420
liming of, 182, 183
new two-bath process of chrome tanning for, 192, 193
notes and suggestions on chrome-tanning of, 194–196
dyeing, 206–209
painting of, with lime and red arsenic, 181, 182
pickling of, 185, 186
process of alum and chrome-tanning for, 190–192
soaking of, 180, 181

Goatskins, tanning of, in paddle vat, 188, 189
with sulphate of alumina, salt soda and chrome liquor, 189, 190
use of patented depilatories for, 498
vegetable-tanned, 219, 220
Gold dust washing powder and acid, bleaching leather with, 228, 229
Golden-rod brown on sheepskin leather, 25
Goldsmith, Byron B., patent of, 523–525
Goodyear welting, manufacture of, 342–344
Goodyears, finishing splits into, 365–367
splits for, 327, 328
Grain, clearing the, and setting the color with tartar emetic, 122
leather, bright boarded, finish for, 335, 336
from splits, formula for making, 368, 369
thin, liming hides for, 260–262
Grained side leather, fat liquor for, 281, 282
Grains, acid-pickled, chrome tannages for, 268–270
bright printed or boarded, fat-liquor for, 334
imperfect, finishing of into patent tipping, 350, 351
quebracho-tanned, coloring of, 338–340
retanning of, with sumac, 327, 328
vegetable-tanned, finishing of, into black leather, 335
Grape sugar and lactic acid, bating calfskins with, 105
Grease, pressing of, from pickled sheepskins, 7
spots, removal of, from leather, 453
Greases, mineral, 501
Greasy leather, sigs for, 449
Green on furs, 172
sheepskin leather, 26, 42
-salted hides, soaking of, 252, 253
Grey on calfskins, 122
furs, 172
goatskins, 205, 206
shades on glove leather, 493
Griffith, Robert W., dyeing and fat-liquoring chrome sheepskins after drying out from the chrome tannage, described by, 29, 30
Grothe, Otto, patent of, 574–576
Gun cotton, 473, 474
metal finish for calfskins, 117, 118
on chrome side leather, 285
Gusset splits, 360

HAIRSKINS, alum-tanned, oiling of, 164
depilatory compounds for, 379–381
greasy, washing of, 163
liming of, 165, 166
oil process for tanning, 163, 164
soaking of, 160
tanning and dyeing of, 160–179
of with alum and gambier, 168
use of patented depilatories for, 498
Handbags, leather for, 292
Hard water, to soften, 410
Harness blacking, 448
leather, bating sides for, 298
blacking and stuffing of, 300, 301
chrome-tanned, 297–301
coloring of, 403
liming sides for, 298
mill-stuffed, bleaching of, 233, 234
pickling sides for, 298, 299
retanning sides for, 299, 300
tanning sides for, 299
use of patented depilatories upon hides for, 499, 500
Heavy chrome grain leather, 286–288
side leather, fat liquor for, 282
Hemlock and quebracho extracts, tanning sides with, 312
tannage for sheepskins, 49, 50
Hides, chrome tanning of, with glucose, glycerine, steam and saccharine substances, 272–275
dry, soaking of, 253, 254
sodium sulphide process for, 257, 258
for plump leather, formula for, 325, 326
robes, coats, etc., cleaning and oiling of, 179
upper leather, liming of, 254–257
green salted, soaking of, 252, 253
liming of, for thin grain, 260–262
methods of bating, 262–265
splitting, 266, 267
pickling of, 265, 266
salting of, to prevent salt stains and loss of weight, 561–564
tanning of, for robes, coats, etc., 176–179
use of patented depilatories upon, 498–500
Horsehides, deliming of, 424
tanning of, for robes, coats, etc., 176–179

Horsehides, use of patented depilatories upon, 500
Hydrolysis, 509
Hydrosulphites, bleaching leather with, 223
Hyraldite, bleaching leather with, 223

ICELAND moss, 471
India-tanned kips, chrome leather from, 303–305
ooze leather, 75
skins, black on, 69, 70
cleaning of, 405, 406
coloring and finishing of, 65–75
retanning of, with chrome liquor, 73
retanning of, with sumac, 67
washing, 66
Indian method of tanning buckskins, 485–487
Intestinal leather, manufacture of, 546–549
Irish moss, 471, 472
Isinglass, 469

KANGAROO leather, black grain and blue or black flesh on, 250
fat-liquoring of, 245, 246
finishing of, 247
imitation, stuffing for, 334
manufacture of, 238–251
oiling and drying of, 246
patented method of finishing, 251
staking and tacking of, 246
vegetable-tanned, 247–251
yellow flesh and black grain on, 251
side leather, finishing of, 336, 337
sides, greasy, sig for, 337
skins, bating and drenching of, 239–241
deliming of, 427
liming of, 238, 239
neutralization and washing of, 244
one-bath process for, 243, 244
pickling of, 241, 243
soaking and softening of, 238
Kangaroo skins, use of patented depilatories, for, 498
Kapak, 572
Kid finish on black sheepskins, 33
Kid glove leather, 218, 219
Killing processes for furs, 173, 174
Kimball, George S., patent of, 569–571
Kips, formaldehyde tannage for, 481, 482
India-tanned, chrome leather from, 303–305
patent tipping from, 305, 306
Klipstein, patent of, 536, 537

LACE leather, alum-tanned, 354–356
chrome, 351–354
manufacture of, 351–356
Lactic acid and bran, bating calfskins with, 104, 105
grape sugar, bating calfskins with, 105
drench for goatskins, 419, 420
sheepskins, 419
in coloring leather, 415, 416
use of, in deliming, 5
Lamb, preparation of algin described by, 472
Lambskin, dyeing of, 175
Lappe, Christian E., and Henry A., patent of, 251
Larson, Martin B., patent of, 560, 561
Leather, bleaching of, 221–237
for the production of a regular and light color, 505, 506
chrome-tanned, process of fat-liquoring, 197, 198
colored, preventing fading of, 416, 417
to dye black, 411, 412
coloring of, lactic acid in, 415, 416
with permanganate of potash, 564–568
condition of, as regards moisture, 500, 501
dressing, waterproof, 448
drum stuffing of, 502–504
dyeing, acetic acid bath after, 416
formic acid in, 415
notes and suggestions on, 408–419
finish, preparation of blood for, 451
finishing of, notes and receipts for, 446–453
for furniture, upholstery, carriages and automobiles, 519–523
organ pipes, 550, 551

Leather for pneumatic tires and other purposes, 529–532
furniture, dressing for, 417
goods, dressing for, 417
greasy, sigs for, 449
heavily stuffed, production of a good color on, 500–506
heavy, notes on tanning of, 322–326
intestinal, manufacture of, 546–549
low-priced, fat liquor for, 391, 392
materials used in finishing, 466-474
neutralization of, 97
plump, formula for producing, 325, 326
poor, process of improving, 541, 542
process of waterproofing, 533
removal of grease spots from, 453
removing spots and stains from, 417–419
retanning of, with gambier and sumac, 326–328
russet colors on, 406, 407
semi-chrome, 95–98
staining, 400–404
tanning and plumping of, with formic aldehyde, 525–529
test for determining whether tanned by the one-bath or two-bath process, 197
Turkey-red oil in tanning, 537–540
vegetable-tanned, blacking for, 448, 449
waterproofing of, 453–458
with severely damaged grain, dyeing of, 403
Leathers, bag and case, manufacture of, 344–350
chrome bag and belt, 292
-tanned, difference between one-bath and two-bath, 196, 197
from cowhides, 252–370
velvet and suede, 152–155
Levant grain, 427, 428
crushed, 74
Lignite distillation, tanning with, in combination with tannic acid, 568–571
Lilac on sheepskins, 42
Lime and sulphide of sodium, liming calfskins with, 103, 104
Liming calfskins, 100–102
for thin grain, 260-262
glove leather, 488, 489
goatskins, 182, 183
hides for plump leather, 325
upper leather, 254–257
kangaroo skins, 238, 239
Liming pigskins, 436
sheepskins after removal of the wool, 3–6
sides for bag and case leathers, 344, 345
harness leather, 298
sole leather, 293
skins preserved by formaldehyde, 476
woolskins, 87, 88
Linings, dye for, 26
split, treatment of, 433, 434
Logwood and direct leather black, dyeing calfskins black with, 111
salt of titanium, blacking calfskins with, 146, 147
leather black and titanium salt, dyeing calfskins black with, 111
liquor, 146, 449
strikers for use after, 150

MC WHITER, John H., patent of, 554, 555
Magnus, Philip, patent of, 531, 532
Marbled effects on sheepskins, 59–61
suede leather, production of, 535, 536
Maumené test, 399, 400
Mill-stuffed harness leather, bleaching of, 233, 234
Miller patent on tanning with formaldehyde, 478
Mineral and vegetable tannage for woolskins, 90, 91
greases, 501
Mitten and glove leathers, calfskin, 129–131
leather, side chrome, 290–292
fat-liquor for, 291
finishing of, 291, 292
Mittens, nappa leather for, 45–48
Mocha castor glove leather, 218, 219
leather from sheepskin splits, 79, 80
Molasses, bating with, 556, 557
Moore, Charles C. and Trantom, William, patent of, 561–564
Mordant for dark tan, 277
fustic, 20, 21
and logwood, 24
gambier, 20
for tan shades on goatskins, 204
sumac and acid color, 24
titanium potassium oxalate, 21
for basic and acid dyes, 204
tannin, for basic dyestuffs, 276
titanium, 151, 152
Mordanting furs, 174, 175

Mordanting with sumac and acid dye, 277
Mordants for calfskins, 120, 121
titanium, for chrome and vegetable-tanned leathers, 412–415
Morocco finish on Indian-tanned skins, 73, 74
Motheral, J., description of Indian method of tanning buckskins by, 485–487
Mozynski, Joszyp, patent of, 559, 560

NAPA leather, coloring of, 47, 48
for gloves, 45–48
tannages for, 45–47
Neatsfoot oil and cod oil, sulphonating of, 386, 387
how to test, 399, 400
Neutralization and washing kangaroo skins, 244
tanned sheepskin leather, 193, 194
of leather, 97
Neutralizing calfskin leather, 110
chrome leather, 372
sheepskins, 12
cowhide leathers, 271
Nigrosine, blue flesh with, 450
Nitro-cellulose, 473, 474
Norris, William M., patent of, 564–566

OAKS patented process of bating, 554, 555
Oil black, 448
process for tanning furs and hairskins, 163, 164
tanning, 539, 540
Oiling alum-tanned furs and hairskins, 164
calfskin leather, 115
chrome goat leather, 213, 214
lace leather, 353, 354
leather, 397–399
kangaroo leather, 246
Oils, sulphonated, how to make and use, 385–390, 462
Ointment for chrome sores, 452
Oleic acid, sulphonating of, 393
Olive green, dark, on sheepskin leather, 26
on sheepskins, 42
One-bath chrome processes for acid-pickled stock, 269, 270
sheepskins, 9–12
tannages, 506–511
process for calfskins, 109, 110
goatskins, 189
One-bath process for kangaroo skins, 243, 244
with sulphate of alumina for calfskins, 109, 110
Ooze calf leather, notes on, 157–159
calfskins, chrome-tanned, 134–138
leather, 74, 75
cleaning of, 419
dyes for, 71
Orange on furs, 172
Organ pipes, leather for, 550, 551
Oropon, bating calfskins with, 104
for deliming sheepskins, 6
Ouachita lignite, 568
Oxalic acid, bleaching leather with, 225, 226
Oxblood color on sheepskin leather, 25, 26
shade on goatskins, 210
side leather, 277, 278
vegetable-tanned sheepskins, 57, 58
shades on calfskins, 125, 126
Ozocerite, 573

PADDLE vat, tanning goatskins in a, 188, 189
Paraffine oils, use of, 398
Parchment-like skin, manufacture of, 549, 550
Paste for wax calf leather, 128, 129
Patent leather, chrome-tanned, 309–311
deliming of, 424–427
pyroxylin in finishing varnish for, 523–525
use of patented depilatories upon hides for, 499, 500
shoe tipping, vegetable-tanned, 340–342
tipping, finishing imperfect grains into, 350, 351
from India-tanned kips, 305, 306
Patented depilatories, methods of using, 496–500
processes of bating and deliming, 552–559
Patents, various, relating to tanning, with specifications, 519–576
Payne and Pullman, patent of, for tanning with formaldehyde, 478, 479
Permanganate of potash, bleaching leather with, 224, 225
methods of coloring leather with, 564–568
Petroleum oil, use of, 398
Phenolphthalein test, 516–518
Phosphine dyestuff, coloring with, 24
Picker leather, 356–358

Pickled sheepskins, alum-tannage for 36–40
Pickling goatskins, 185, 186
hides, 265, 266
for chrome-tanned patent leather, 309, 310
kangaroo skins, 241–243
sheepskins with acid and salt, 6, 7
sides for bag and case leathers, 345, 346
harness leather, 298, 299
sole leather, 294
skins, use of butyric acid in, 107
use of acids in, 419–427
with formic acid and salt, 107, 108
sulphuric acid and salt, 107
Pigskin leather, manufacture of, 435–441
Pigskins, bating of, 437
liming of, 436
tanning of, 437–439
unhairing, 436
washing and degreasing of, 436
white, 439–441
Plump leather, formula for producing, 325, 326
Pneumatic tires, leather for, 529–532
Porpoise skins, tanning of, 534. 535
Potash soaps, 394, 395, 464, 465
Preservation of skins, 475, 476
Pressing side leather, 322
Processes, receipts, formulas and notes, 371–518
Purplish-blue flesh on calfskins, 148
Pyroxylin, 473, 474
in finishing varnish for patent leather, 523–525

QUEBRACHO extract, characteristics of, 312, 313
points to be observed in the use of, 313, 314
tannage for calfskins, 138, 139
tanning sides with, 312–315
Quebracho extract tannage for kangaroo leather, 247, 248
tannage for sheepskins, 38, 49
tanned grains, coloring of, 338–340
skins, coloring, 155–159

RACOON, dyeing of, 175
Red on furs, 172
brown on side leather, 278
haired fox, dyeing of, 175, 176
Retanning calfskins for wax calf leather, 127
Retanning chrome leather, 372, 373
grains with sumac, 327, 328
India-tanned skins with chrome liquor, 73
sumac, 67
leather with gambier and sumac 326–328
sides for harness leather, 299, 300
Riederer, Herman S., wash for chrome sores, recommended by, 452
Roberts, patent of, for preserving skins, 475
Robes, tanning of hides for, 176–179
Roller leather, 85, 86
Rose color on sheepskins, 42
Rosin oil, fat-liquors prepared with, 396, 397
oils, objection to, 465
Rough bag and case leather, finishing of, 348–350.
Rubber, waterproofing leather with, 454–457
Rugs, white fur, cleaning of, 168
Russet colors on leather, 406, 407
leather, bleaching and finishing, 232, 233
colorless dressing for, 233
skirting leather, 234, 235
upper leather, coloring of, 403
Russia chrome leather, notes on, 157–159

SAL-ammoniac and salt in bating calfskins, 105, 106
bating with, 421, 422
Salting hides to prevent salt stains and loss of weight, 561–564
Salts, dissociation of, 508, 509
Schlegel, Henry, patent of, 553, 554
Seal, English imitation of, dyeing of, 176
large, 427
rabbit, dyeing of, 176
small or white coat, 427
splits for white shoes, 434, 435
Sealskins, bating of, 428, 429
blacking, 430
finishing of, 432, 433
tanning of, 427–435
unhairing, 428
Seasoning for black glazed finish, 32
colored chrome calfskins, 118
goat leather, 216
sheepskins, 33, 34
dull finish, 33
on calfskin, 116
on chrome side leather, 284

Seasoning for glazed chrome upper leather, 446, 447
finish, 32, 33
for calfskins, 116, 117
on chrome side leather, 284, 285
Seasonings for colored sheepskins, 63, 64
Semi-chrome leather, 95–98
Shark skins, tanning of, 534, 535
Shearlings, coloring of, 92–95
Sheepskin fleshers, 78–80
leather, alum-tanned, coloring of, 40–43
Bismark brown on, 25
champagne color on, 25
chocolate brown on, 25
coloring of, after fat-liquoring, 26, 27
dark olive-green on, 26
dark tan on, 24
golden-rod brown on, 25
green on, 26
ox-blood color on, 25
soft white, alum tannage for, 39, 40
leathers, manufacture of, 1–98
splits for stock resembling castor or mocha leather, 79, 80
Sheepskins, azure blue on, 42
black glazed finish on, 31–33
kid finish on, 33
blacking of, 12–14
bronze dyeings on, 61–63
camel brown on, 41
chestnut brown on, 41, 42
chrome, coloring of, 17–31
dyeing and fat-liquoring of, after drying out from the chrome tannage, 29, 30
fat liquors for, 14–17
finishing of, 31–45
flesh finished, 27, 28
neutralizing and washing, 12
coffee brown on, 42
colored, re-dyeing black, 14
seasonings for, 33, 34, 63, 64
coloring of, with natural dyestuffs, 41–43
dark yellow on, 42
degreasing of, 34–36
deliming of, 4–6
depickling of, 40
drenching of, 4–6
dry, soaking of, 1, 2
embossed, finish for, 64, 65
flesh color on, 42
formaldehyde tannage for, 480, 481
Sheepskins, green on, 42
lactic acid, drench for, 419
lilac on, 42
liming of, after removal of the wool, 3–6
olive green on, 42
pickled, alum-tannage for, 36–40
pressing grease from, 7
pickling of, 6, 7
removing wool from, 2, 3
rose color on, 42
salted, soaking of, 1
seasoning for dull finish on, 33
soaking of, 482–485
splitting and shaving, 96
tanning of, with formaldehyde, 43–45
two-bath chrome tanning of, 7–9
vegetable tanned, 48–53
cleaning bath for, 55
dyeing of, 53–75
fat-liquoring of, 59
white chrome-tanned, 30, 31
Shellac, 472, 473
Shoe leather, bright blacking varnish for, 447, 448
tipping, vegetable tanned patent, 340–342
Shoes, white, seal splits for, 434, 435
Side glove leather, chrome, 290–292
leather, chrome, fat liquors for, 280–283
finishing of, 283–290
tanning of, 268–271
dyeing of, 275–280
pressing and splitting of, 322
vegetable-tanned, coloring of, 337–340
tanning process for, 311–326
white, 306–308
leathers, fat-liquoring and finishing of, 331–337
mitten leather, chrome, 290–292
Sides for bag and case leathers, bleaching and coloring of, 347, 348
harness leather, bating of, 298
liming of, 298
pickling of, 298, 299
retanning of, 299, 300
tanning of, 299
sole leather, deliming of, 293
liming of, 293
pickling of, 294
soaking of, 293
tanning of, 294–296

Sides, unsplit, tanning of, 271
Sig for greasy kangaroo sides, 337
Sigs for greasy leather, 449
S. K. solution, 192, 193
Skin, parchment-like, manufacture of, 549, 550
substance, conservation of, 381, 382
Skins, clearing and coloring of, 404–406
deliming and pickling of, with formic acid, 420, 421
heavy, fat-liquor for, 199
in process, drying of, 382–384
pickling of, with formic acid and salt, 107, 108
sulphuric acid and salt, 107
preparation of, for tanning with formaldehyde, 480
preservation of, 475, 476
preserved by formaldehyde, soaking and liming of, 476
salted, use of patented depilatories for, 496–498
with the hair on, to bleach, 169
Skivers, 76–78
clearing and coloring of, 404–406
flat finishing of, 76–78
Skunk, imitation, dyeing of, 175
Small seal, 427
Smith, William R., patent of, 571–573
Smooth dull finish for calfskins, 117
Snake skins, tanning of, 445, 446
Soaking and softening kangaroo skins, 238
dried goatskins, 180, 181
dry calfskins, 99, 100
dry hides, 253, 254
furs and hairskins, 160
green-salted calfskins, 99
hides, 252, 253
hides for plump leather, 325, 326
sheepskins, 482–485
sides for sole leather, 293
skins preserved by formaldehyde, 476
Soap black, 364, 365
castor oil, how to make, 394
fat-liquor, 390, 391
fig, 465
of sulphonated castor oil, preparation of, 392, 393
Soaps, potash, 394, 395, 464, 465
Sodium bichromate, 507
peroxide, bleaching leather with, 224
sulphide process for dry hides, 257, 258
Softening heavy splits, 362, 363
Sole leather, bleaching of, 235–237
chrome-tanned, 293–296
Sole leather, drum tanning for, 369, 370
durable, 323–325
firmness in, 477, 478
use of patented depilatories upon hides for, 498, 499
waterproof filling for, 571–573
Soluble cotton, 473, 474
Solution-pressure, 509
Split linings, treatment of, 433, 434
sealskins, bating, scudding and drenching, 431
sealskins, tanning of, 431, 432
Splits, chrome-tanned, 358–360
finish for the black, 364
finishing of, 358–369
into Goodyears, chair splits, etc., 365–367
for flexibles, 327, 328
Goodyears, 327, 328
formula for making grain leather from, 368, 369
heavy, softening and stuffing of, 362, 363
vegetable-tanned, 360–362
white, 367, 368
with severely damaged grain, dyeing of, 403
Splitting and shaving sheepskins, 96
hides, 266, 267
after tanning, 267
out of lime, 266
sulphate of alumina and salt pickle, 266, 267
leather, 322
sealskins, 430, 431
side leather, 322
Sporting shoes, chrome-tanned side leather for, 158, 159
Spots, removing of, from leather, 417–419
Staining leather, 400–404
Stains on hands, how to remove, 452, 453
removing of, from leather, 417–419
Staking chrome goat leather, 213, 214
chrome-tanned patent leather, 310, 311
kangaroo leather, 246
Stick lac, 473
Storing and dissolving dyestuffs, 408–410
Storm-grain side leather, finish for, 286
Strap leather, 303
bleaching of, 226–228
Striker, formula for, 337
Strikers for table dyeing, 450, 451
use after logwood, 150
Stripping tannage from sheepskins, 96, 97
Stuffing for wax splits, 363, 364

Stuffing harness leather, 300, 301
heavy splits, 362, 363
Suede and velvet leathers, 152–155
leather, 74, 75
black on, 154, 155
finishing of, 137, 138
marbled, production of, 535, 536
tan on, 492, 493
Sugar of lead and acid, bleaching leather with, 222, 223
Sulphate of alumina and salt, pickling goatskins with, 186
tanning white calfskin leather with, 132
side leather with, 307
Sulphide of sodium for soaking calfskins, 99, 100
Sulphonated castor oil, preparation of, 392, 393
oil and sal ammoniac, bating with, 552, 553
oils, 385–390, 462, 463
Sulphuric acid and salt, pickling goatskin with, 186
pickling with, 107
Glauber's salt and borax, bating with, 554
Sulphurous acid, preparation of, 84
Sumac, alum and salt, tanning sheepskins with, 53
and acid color mordant, 24
acid dye, mordanting with, 277
titanium-potassium oxalate, 21
mordant, 121
for basic and acid dyes, 204
retanning grains with, 327, 328
India-tanned skins with, 67
tannage for sheepskins, 52
Swelling in vegetable tanning, fixing the, 476–479
S. Z. solution, 192, 193

TABLE dyeing, strikers for, 450, 451
Tacking kangaroo leather, 246
Tan, dark, mordant for, 277
on sheepskin leather, 24
on calfskin glove leather, 131
calfskins, 123, 124, 125
cape grain skins, 492
suede leather, 492, 493
woolskins, 94
shades on goatskins, 204, 205, 210
gambier mordant for, 204
vegetable tanned sheepskins, 58, 59
Tannage, combination for calfskins, 142, 143
combined vegetable and mineral, 536, 537
Tannage, dongola, for calfskins, 141, 142
for chrome-tanned ooze calfskins, 135
roller leather, 85
sheepskin fleshers, 78
skivers, 76
woolskins, 88
gambier and salt, 560, 561
for calfskins, 139–141
mineral and vegetable for woolskins, 90, 91
quebracho, for calfskins, 138, 139
quick waterproof, 559, 560
stripping the, from sheepskins, 96, 97
Tannages, one-bath chrome, 506–511
various, for kangaroo leather, 249, 250
Tannic acid, tanning with lignite distillation, in combination with, 568–571
Tannin mordant for basic dyestuffs, 276
Tanning agent, preparation of a, from waste products of wood-pulp manufacture, 574–576
and dyeing of furs and hairskins, 169–179
plumping leather with formic aldehyde, 525–529
buckskins, 441–445
Indian method of, 485–487
calfskin glove leather, 129, 130
fish and other similar skins, 534, 535
goatskins in a paddle vat, 188, 189
with sulphate of alumina, sal soda and chrome liquor, 188, 190
hairskins with alum and gambier, 168
hides for chrome-tanned patent leather, 309, 310
plump leather, 325, 326
leather, Turkey-red oil in, 537–540
liquor, basicity of, 508
for glove leather, 489, 490
material, alkali and acid, bleaching leather with, 229–232
novel method of, 542, 543
of heavy leather, notes on, 322
hides for robes, coats, etc., 176–179
woolskins, 86–95
oils, 394
pigskins, 437–439
sealskins, 427–435
sides for bag and case leathers, 346, 347
harness leather, 299
sole leather, 294–296
snake skins, 445, 446

Tanning splits, 361, 362
various patents relating to, with specifications, 519–576
white calfskin leather with sulphate of alumina. 132
side leather, 307
with alfalfa extract, 554, 555
formaldehyde, 43–45
German process of, 543–545
patents on, 478, 479
gambier, sumac and oak extract, 384
lignite distillation in combination with tannic acid, 568–571
woolskins with alum, salt and hemlock extract, 91, 92
Tanolin, 47, 269, 270
Tartar emetic, cleaning the grain and setting the color with, 122
use of, 206
Testing neatsfoot oil, 399, 400
Tipping, patent, finishing imperfect grains into. 350, 351
from India-tanned kips, 305, 306
Titanium mordant of colors, 151, 152
mordants for chrome and vegetable-tanned leathers, 412–415
Traveling bags, leather for, 292
Trenckmann, Bruno, patents of, 546–550
Turkey-red oil in tanning leather, 537–540
Two-bath chrome processes for acid-pickled grains, 268, 269
tanning of sheepskins, 7–9
process for calfskins, 108, 109
new, of chrome tanning for sheepskins, 192, 193
processes for chrome tanning goatskins, 186–188

UNHAIRING calfskins, 100–102
pigskins, 436
sealskins, 428
Unsplit sides, tanning of, 271
Upholstery, leather for, 519–523
Upper leather, chrome, fat liquor for, 281
glazed chrome, seasoning for, 446, 447
heavy, deliming of, 424–427
liming of hides for, 254–257
process of finishing, 532, 533
vegetable-tanned, coloring and finishing of, 328–331

VARNISH, bright blacking for shoe leather, 447, 448
finishing, for patent leather, pyroxylin in, 523–525
Vegetable-tanned calfskin leather, manufacture of, 138–152
calfskins, coloring of, 146–152
fat-liquoring of, 143–146
goatskins, 219, 220
grains, finishing of into black leather, 335
kangaroo leather, 247–251
leather, black stain on, 404
blacking for, 448, 449
titanium mordants for, 412–415
patent shoe tipping, 340–342
sheepskins, 48–53
dyeing of, 53–75
side leather, coloring of, 337–340
skins, black on, 414, 415
splits, 360–362
upper leather, coloring and finishing of, 328–331
tanning, fixing the swelling in, 476–479
process for side leather, 311–326
Velvet and suede leathers, 152–155
leather, black on, 154, 155
chrome, 308
finishing of, 137, 138
Violet dye, preparation of, 42
on furs, 172

WALRUS grain seal, 430
Warter, A., and Koegel, H. C., patent of, 540, 541
Washing and scouring woolskins, 86, 87
chrome sheepskins, 12
cowhide leathers, 271
India-tanned skins, 66
pigskins, 436
Water for dissolving dyes, 408
hard, calcareous, correction of, 408
to soften, 410
Waterproof filling for sole leather, 571–573
finish for colored bag and case leathers, 349, 350
leather dressing, 448
without oily surface, 453, 454
tannage, quick, 559, 560
Waterproofing chrome sole leather, 296, 297

Waterproofing leather, 457, 458, 533
with rubber, 454–457
Wax calf leather, blacking of, 128
chrome, 126–129
paste for, 128, 129
splits, stuffing for, 363, 364
Welting, Goodyear, manufacture of, 342–344
Whale skins, tanning of, 534, 535
White buckskin, 441–443
calfskin leather, 132–134
chrome buckskin, 444, 445
sheepskins, 30, 31
coat seal, 427
fur rugs, cleaning of, 168
grain leather, cleaning of, 419
leather, soft, alum tannage for, 39, 40
pigskins, 439–441
shoes, seal splits for, 434, 435
side leather, 306–308
splits, 367, 368
Wilson, N., patent of, 554
Woodpulp, preparation of a tanning agent from waste products of manufacture of, 574–576
Wool, increasing the affinity of, for the dye, 92, 93
Wool, removing of, from sheepskins, 2, 3
Woolskins, bleaching, 89
chrome-tanned, 166, 167
coloring of, 92–95
degreasing, 89, 90
depilatory compounds for, 379–381
liming, 87, 88
tanning of, 86–95
washing and scouring, 86, 87

YELLOW back on calfskins, 148, 149
dark, on sheepskins, 42
flesh and black grain on kangaroo leather, 251
vegetable-tanned upper leather, 330, 331
glove leather, 290, 291
on furs, 172
glove leather, 130, 131

ZINC chloride for conservation of skin substance, 381, 382

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